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TWENTY-NINTH ANNUAL REPORT

OF

THE LOCAL GOVERNMENT BOARD,

1899–1900.

SUPPLEMENT

CONTAINING THE

REPORT OF THE MEDICAL OFFICER

For 1899–1900.

Presented to both Houses of Parliament by Command of Her Majesty.

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ANNUAL REPORT

OF THE

MEDICAL OFFICER

OF

THE LOCAL GOVERNMENT BOARD

FOR THE YEAR

1899-1900.

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REPORT.

MEDICAL OFFICER'S REPORT.

TO THE RIGHT HONOURABLE HENRY CHAPLIN, M.P., PRESIDENT OF THE LOCAL GOVERNMENT BOARD.

SIR,

IN supplement to the Board's Twenty-ninth Annual Report, I have the honour to render account of the work done through the Medical Department in 1899-1900.

The year 1899 will be ever memorable in the annals of the Medical Department by the loss of its principal officer, Sir Richard Thorne, K.C.B. He died suddenly, actually in harness, on the 18th December. By his death the Department is deprived of a chief who most worthily upheld the principles and traditions handed down by his predecessors. The Board and the Public Health Service of the country as a whole have lost an adviser and administrator of the highest order. Not least will loss of Sir Richard Thorne be deplored when in future England meets the Representatives of European and other Foreign States in International Conference on public health questions.

Other loss to the Board in the year now under review occurred by the death in March, 1900, of Dr. Robert Cory, for many years Director of the Board's Animal Vaccine Establishment. There can be little doubt that Dr. Cory's death was indirectly brought about by his zeal in the best interests of vaccination—the prophylactic procedure which his etiological and experimental labours have gone far to place on a scientific and at the same time practical basis.

The vacancy created on the Medical Staff by the death of Sir Richard Thorne led to your appointing Dr. Franklin Parsons, Second Assistant Medical Officer, to the post of First Assistant Medical Officer, rendered vacant by my own promotion, and Dr. Bruce Low to the post of Second Assistant Medical Officer. These promotions gave rise to a vacancy on the Inspectorial Staff, and you appointed Dr. Edward Petronell Manby thereto.

The present report relates almost wholly to the proceedings of the Medical Department during the later months of Sir Richard Thorne's tenure of office.

1. VACCINATION AND PUBLIC VACCINATION.

VACCINATION OFFICERS' RETURNS.

The digest of Vaccination Officers' Returns (Appendix A, No. 1) has reference to children whose births were registered during the calendar year 1897. It is compiled from the Twenty-

MEDICAL OFFICER'S REPORT.

sixth Annual Return under the Act of 1871, and deals with 927,518 births. Of the children in question, 62·4 per cent. were returned as successfully vaccinated, 11·2 per cent. as having died unvaccinated, 0·3 per cent. as "insusceptible," and 3·4 per cent. as having had obtained for them (under the Act of 1898) certificates of "conscientious objection." The remaining 22·7 per cent., including a number returned as postponed, removed, or not to be traced, constitutes a larger amount of default than any yet recorded for England and Wales. For the Metropolis the figures are 29·1, and for the rest of the country 21·6.

INSPECTION OF PUBLIC VACCINATION.

Inspection of public vaccination in 286 unions, including 1,461 vaccination districts, was made by medical inspectors in 1899, and the public vaccinators of 1,083 out of the 1,461 districts were recommended for award under Section 5 of the Vaccination Act of 1867. (Appendix A, No. 2.)

NATIONAL VACCINE ESTABLISHMENT.

Glycerinated calf lymph was, in response to 47,097 applications from public vaccinators, issued in 1899 to the amount of 499,281 capillary tubes. (Appendix A, No. 3.)

ANIMAL VACCINE ESTABLISHMENT.

The primary vaccinations performed at the Board's Animal Vaccine Establishment during 1899–1900 number 2,614. Of these infants, 980 were vaccinated calf-to-arm, and other 1,634 were vaccinated with the Board's glycerinated calf lymph. Details of the work carried out at this station will be found in the report (Appendix A, No 4) of Mr. Stott, who was at the end of the year Acting-Director of the Animal Vaccine Establishment.

GLYCERINATED CALF LYMPH.

The provisional arrangements at the Animal Vaccine Establishment, at the Jenner Institute of Preventive Medicine, and at the National Vaccine Establishment, for the production, testing, preservation, and distribution of glycerinated calf lymph have, notwithstanding the extension of them referred to by Sir R. Thorne in his last report, proved inadequate. Accordingly, at the close of the year 1899–1900 negotiations were proceeding for setting up the several establishments on a wider and more satisfactory basis.

In Appendix A, No. 5, Dr. Blaxall reports on the operations of the Board's Glycerinated Lymph Establishment during 1899–1900, and gives details of the difficulties that were encountered in satisfying the demands that were made on his department. Mr. Fremlin furnishes (Appendix B, No. 10) account of the bacterial flora of vaccine lymph.

2. OTHER ADMINISTRATIVE BUSINESS OF THE MEDICAL DEPARTMENT.

The staff of the Medical Deparment at office have, as in former years, conferred with representatives of local sanitary authorities on the particular needs of their districts in relation to proposed byelaws, and on local proposals for hospital provision in reference to the suitability of selected sites and the disposition of hospital buildings thereon.

In addition to these office conferences, Medical Inspectors have visited and conferred with various sanitary bodies and their officers on like matters. Similarly, Medical Inspectors have rendered service to Medical Officers of Health who have stood in need of guidance and advice with regard to the performance of their duties. Inquiries, too, have been made in usual course in cases where there was mention of vaccination in certificates of death received by local registrars.

Local inquiries of more formal sort have been held by Medical Inspectors in regard of proposals as to hospital provision and accommodation for Abingdon (Joint), Aston Manor, Basingstoke, Bedford (Rural), Blackburn, Bridlington, Burnley (Joint), Carnforth, Chelmsford, Clacton, Clare and Bumpstead (Joint), Colwyn Bay and Colwyn, Coventry, Croydon and Wimbledon (Joint), Cuckfield (Rural), Ealing, East Ham, Eastry (Rural), Gloucester, Guildford (Joint), Hinckley, Leeds, Leigh (Joint), Lincoln, Liverpool, Llandudno, Meltham, Middlesbrough, Nelson, Norwich, Oakwell (Joint), Pontefract (Joint), Richmond, Heston and Isleworth (Joint), Rochford (Rural), Romford (Joint), Royston, Ashwell, and Melbourne (Joint), Salford, Scarborough, Sheffield, Skipton (Urban and Rural) and Silsden (Urban) (Joint), Southall-Norwood, Southampton County Council (Petersfield District), South Shields (Urban), South Shields (Rural), Thanet, Isle of, Ticehurst (Rural), Tring, Upton-on-Severn and Pershore Rural (Joint), Wallasey, Wallingford and Crowmarsh Rural (Joint), Walthamstow, West Riding County Council (Wharfedale Joint Board), Wilts County Council (Swindon District), Withington, Wood Green, Worcester County Council (Bromsgrove, Droitwich and Redditch District), (Malvern District), and (Stourbridge and Halesowen District), and as to appeal by Emley and Meltham Urban Councils against the inclusion of their districts in hospital schemes of the West Riding County Council.

Similar local inquiries were held as to the provision of disinfectors: at Fulham by Dr. Bulstrode, and at Leyton and Todmorden by Dr. Fletcher. The last named inspector also held inquiry as to the provision of a mortuary at Huntingdon. Local investigation by Medical Inspectors, in association when deemed necessary with the Board's Architect, were made as to the adaptation of byelaws to local needs: at Artington, in the Guildford Rural District, and at Yatton in the Long Ashton Rural District (Dr. Bulstrode); at Bury, at Drayton-le-Hales, in the Drayton Rural District, and at Sowerby Bridge (Dr. Buchanan); at Knockholt, in the Bromley Rural District (Dr. Bruce Low); and at Oswestry (Dr. Darra Mair).

Proposals as to sewage disposal were made subjects of joint local inquiry by Medical Inspectors and Engineering Inspectors:

at Bingley, Drayton, Ramsbottom, and Wells, Somerset (Dr. Buchanan); at Wivenhoe (Dr. Bulstrode); and at Festiniog, Manchester, and Newmarket (Dr. Thomson). Similar joint inquiry as to water supply was made: at Bolton, and Bude and Stratton (Dr. Buchanan); at Croydon (Dr. Wheaton); Llandrindod Wells (Dr. Mair); and Richmond, Surrey (Dr. Thomson). At Chester there was similar inquiry as to the formation of a Joint Board under the Rivers Pollution (Prevention) Act in respect of the River Dee (Dr. Deane Sweeting).

The requirements of localities in the matter of public scavenging were investigated in the following districts, namely: Alfreton, by Dr. Reece; Baldock and Long Ashton Rural, by Dr. Bulstrode; Bolsover, by Dr. Buchanan; Coalville, by Dr. Wheaton; Driffield Rural, by Drs. Fletcher and Sweeting; Gillingham and Shelf, by Dr. Sweeting; and Sutton Bridge, by Dr. Mair.

Inspections were made (Appendix A, No. 6) with regard to the incidence of disease and to questions concerning local sanitary administration in various localities, namely: As to diphtheria at Aberdare by Dr. Thomson, and at Aldershot by Dr. Reece; as to enteric fever at Bilston and Coseley by Dr. Mair, at Chichester by Dr. Thomson, at Coleford by Dr. Fletcher, at Falmouth by Dr. Buchanan, at Heanor, Ilkeston, and parts of the Basford Rural District by Dr. Wheaton, and at Shirebrook (Blackwell Rural District) by Dr. Copeman; as to scarlet fever at Norman Cross by Dr. Bruce Low, and at Walmer by Dr. Sweeting; as to anomalous illness at South Witham (Grantham Rural District) by Dr. Bruce Low; as to smallpox at Hull by Dr. Johnstone; as to suspected shipborne plague at Liverpool and as to alleged fatal plague in Suffolk by Dr. Bulstrode; as to sanitary circumstances and administration in the Borough of Windsor by Dr. Bulstrode; in the Urban District of Consett by Dr. Wheaton; in the Urban District of Idle, and the Rural Districts of Braintree, Chelmsford, and Tendring by Dr. Fletcher; in the Rural Districts of Axminster, Biggleswade, and Chailey by Dr. Mivart; in the St. Dogmells Rural District and in the Dartford Registration District (comprising Bexley, Erith, and Dartford Urban Districts and Dartford Rural District), by Dr. Sweeting; and as to the permanent constitution of the Manchester Port Sanitary District by Dr. Reece.

In view of possible importation of plague, the following port sanitary districts were specially visited by members of the Medical Staff, namely: Barnstaple, Barry and Cadoxton, Bridgwater, Bristol, Cardiff, Exeter, Falmouth and Truro, Fleetwood, Fowey, Gloucester, Hartlepool, Hull and Goole, King's Lynn, Lancaster, Liverpool, London, Lowestoft, Manchester, Newport (Mon.), Padstow, Plymouth, Portsmouth, River Blyth, River Tees, River Tyne, Southampton, Sunderland, Swansea, Workington, and Great Yarmouth. Similar visits were paid to the Barrow-in-Furness, Berwick, Holyhead, Holme Cultram, Llanelly, Maryport, Millom, and Whitehaven Urban Districts; and to the Llanelly Rural District. In addition, inquiry was made by Dr. Reece as to the measures of precaution which would, in the event of plague being imported, be carried out in connection with seamen's common lodging-houses in Greenwich, Limehouse, Poplar, Rotherhithe, St. George-in-the-East, West Ham, and Whitechapel.

Sir Richard Thorne continued until his death a Member of the Royal Commission on Sewage Disposal. In this capacity, as in others, loss of him is well-nigh irreparable.

Dr. Parsons, one of your Assistant Medical Officers, was appointed, during the year, Member of the Departmental Committee charged with inquiry into the organisation and staff of the Geological Survey. In pursuance of the operations of this Committee, Dr. Parsons prepared a Memorandum "On the utility of the Geological Survey in relation to Questions of Public Health and Sanitary Administration coming under the cognizance of the Local Government Board," which will no doubt appear in due course in the Report of the Committee.

Dr. Bulstrode was, during the year, appointed Member, and Mr. C. J. Huddart, the Medical Officer's Statistical Assistant, was appointed Secretary, of the Departmental Committee which has the duty of ascertaining the nature of the substances used for the preservation and colouring of one and another food, the extent to which such substances are used, and the danger, if any, of such use.

As regards certain of the investigations and inquiries by Medical Inspectors, it was the intention of Sir Richard Thorne to discuss the reports of these officers in his annual volume. The reports in question are accordingly added in appendix. They concern:—

Enteric fever in Chichester (Appendix A, No. 7).

The sanitary condition of Windsor (Appendix A, No. 8).

The gathering grounds and water-works of the Bolton Corporation (Appendix A, No. 9).

Sanitary circumstances and administration at Aldershot (Appendix A, No. 10).

Epidemic enteric fever at Falmouth (Appendix A. No. 11).

NOTIFICATION AND DEATH RETURNS.

In Appendix A, No. 12, will be found a compilation, quarter by quarter for the year 1899, of the notified attacks and the registered deaths from certain infectious diseases in 93 urban sanitary districts of England and Wales. Like information, week by week for the year, is afforded for the several sanitary districts of the Metropolis.

Appendix A, No. 13, gives similar data, collated under the direction of Sir Richard Thorne, in regard of urban districts (76) caused by the life processes of a specific bacillus, quite distinct from the tubercle bacillus. The bacillus in question was first isolated by A. Pfeiffer, and has been named "bacillus pseudo-tuberculosis."

Dealing with the subject in the latter sense, Dr. Klein has, during 1899–1900, made comprehensive study of pseudo-tuberculosis (Appendix B, No. 1). He has investigated and described the clinical history, the post-mortem appearances, and the histology of the morbid processes of numerous animals in which pseudo-tuberculosis had been induced indifferently by inoculation into the groin, by intraperitoneal injection, and by feeding.

As regards the principal animals of experiment—guineapigs, rabbits, and mice—he found that the course of pseudo-tuberculosis was relatively more rapid than that of tuberculosis. Histologically the "giant cell" formation which commonly accompanies tissue necrosis due to tuberculosis is almost entirely absent in pseudo-tuberculosis; while, of course, each disease is accompanied by its characteristic bacillus. In nearly all other respects the pathological similarity between pseudo-tuberculosis and tuberculosis was strikingly close, and it deserves notice that this similarity was nowhere closer than when the diseases in question had been artificially induced by feeding.

Knowledge of the pathology and etiology of pseudo-tuberculosis is of value, not only by facilitating the detection of the disease as it occurs under natural conditions in lower animals—and possibly even in man—but also in view of the frequency with which inoculation of rodents, in which this disease is readily induced artificially, is used to aid and confirm the diagnosis of tubercle. The bacillus of pseudo-tuberculosis, Dr. Klein has found, is by no means sparsely distributed. Thus he has detected it in samples of unfiltered Thames and Lea water, in minimal quantities of sewage, and in certain sewage effluents. As regards milk, with which inoculation of guineapigs is frequently practised to detect the presence of tubercle bacilli, his experience is noteworthy. Two out of five samples of milk purchased at London shops, and six out of 97 samples of milk delivered at London railway stations direct from dairy farms, produced pseudo-tuberculosis on inoculation into guineapigs.

In course of numerous inoculation experiments, Dr. Klein has studied the effect of inoculating with cultures of the bacillus of pseudo-tuberculosis animals which not long before had been inoculated with tuberculous matter. The resulting pseudo-tuberculosis in no instance appeared to have been retarded; the two diseases, tuberculosis and pseudo-tuberculosis, being capable of progressing simultaneously, though not at equal rates, in one and the same animal. Hence in such an animal lesions which seemingly form part of a single pathological process may be found associated, some with tubercle bacilli alone, others with bacilli of pseudo-tuberculosis alone, and elsewhere with a "mixed infection" of both these microbes.

BACTERIOLOGY OF SCARLATINA.

Dr. Gordon has continued his study of the bacteriology of scarlatina. Investigation of this subject was commenced by Dr. Klein as long ago as 1885, in connection with "milk-scarlatina," and was resumed in recent years by him in conjunction with Dr. Gordon when "return cases" of scarlatina were causing difficulties in hospital administration. As a result, alike of later and of former investigation, a micro-organism belonging to the streptococcus group of bacteria, the so-called S. Scarlatinæ, was indicated as in all probability the microbic cause of scarlatina; indeed, as regards the joint investigation by Drs. Klein and Gordon, the infectiveness of this disease, whether in its active or its convalescent stages, was judged to be parallel with the presence or with the persistence in the patient's throat of the micro-organism in question.

But the conclusions of the Board's investigators were not generally accepted. Bacteria of the streptococcus group are micro-organisms morphologically and biologically unstable; and hence, it would seem, differentiation of them by one and another worker has been held to be largely a matter of personal equation. In these circumstances Dr. Gordon was charged with the duty of strict scrutiny of streptococci generally, with a view of ascertaining the several biological phases of each member of the group under differing conditions and according as it was derived from diverse sources. This proved a laborious undertaking, which has occupied Dr. Gordon upwards of two years. But the research was well worth the time and sustained attention thus bestowed on it; for not only has it enabled Dr. Gordon to confirm his and Dr. Klein's previous observations as to the constant presence of streptococcus scarlatinæ in the throats of patients suffering from mild and uncomplicated scarlatina, but has equipped him more completely perhaps than any other observer for profitable study of an aspect of scarlatina that has hitherto received too little attention.

The body of a person dead of scarlatina—the heart's blood, organs and tissues—is to be thought of as furnishing in abundance, if only identifiable, the micro-organisms or micro-organism the life processes of which have brought about a fatal termination of the malady. This was Dr. Gordon's view. And accordingly, having fitted himself in the way I have shown for differentiation of bacteria concerned in death by septicæmia (such as is fatal scarlatina), he set himself to ascertain what, if any, was the predominant micro-organism in the tissues and organs of the scarlatina body; to ascertain, in fact, whether or not such micro-organism could be identified with streptococcus scarlatinæ.

Dr. Gordon's report for 1899–1900 (Appendix B, No. 2), which is devoted almost wholly to account of his recent work in the above direction, goes to establish, as I consider, on a wide basis of inference a very strong presumption that the predominant micro-organism in the dead scarlatina body is not only a bacterium of the streptococcus group, but a streptococcus also which is, derivatively and potentially, one and the same with streptococcus scarlatinæ or conglomeratus; with the micro-organism, that is, the presence of which in the throats of scarlatina patients and convalescents has been judged parallel with their infectiveness to other persons. Dr. Gordon's detailed account of his work must needs be studied with particular interest by all investigators of the intimate pathology of contagion. Whatever their verdict on Dr. Gordon's inferences, none will deny that the work he has done redounds highly to his credit, and to that of the Board.

STREPTOCOCCI IN WATER.

The significance of the presence of streptococci (and incidentally of staphylococci) in water, in regard of its pollution by animal organic matter, has been further studied by Dr. Houston during 1899–1900 (Appendix B, No. 3). On the one hand, in pure water, and in the washings of virgin soil, he has uniformly failed to detect microbes of the streptococcus class. On the other hand, streptococci are habitually found in such small volumes of crude sewage as $\frac{1}{1000}$ cc., and ordinarily they are abundant in minimal quantities of human fœcal matters. These circumstances led Dr. Houston to the belief that discovery of streptococci in a water sample affords a very valuable indication, not merely that the water has been contaminated by animal organic matter—for this may be ascertained by other, easier, and more certain bacterial tests—but that the contamination in question has been of quite recent occurrence, and to a corresponding extent of a sort peculiarly dangerous to a water service. Examination of many samples collected from rivers at points where their waters possessed greater or less liability to recent and continuing contamination by sewage has tended to confirm Dr. Houston's anticipations. In instances where there could be no question of sewage pollution having been quite recent, streptococci were found in minimal amounts (sometimes in as little as $\frac{1}{1000}$ c.c.) of the samples. In other instances, where pollution, demonstrable by chemical and by other bacterial tests, was more remote in its origin, no microbe of the streptococcus class could be detected. The parallel examinations, chemically and by other bacterial test, which were undertaken by Dr. Houston of the various waters, give additional interest to his results as regards streptococci.

In an addendum to this report Dr. Houston describes a method by which the production of gas in "gelatine shake" cultures may be conveniently utilised as a rough test of considerable value in indicating the extent to which biological purification has been carried in the case of polluted rivers and of effluents from sewage works.

BACTERIOLOGICAL EXAMINATION OF SOIL-WASHINGS.

In last year's report reference was made at some length to the progress of Dr. Houston's search for means by which the bacteriologist, dealing with a water service to which flood water has access, can ascertain whether during time of storm the waters of doubtfully clean surface soils have been contaminating the supply. In 1899–1900 (Appendix B, No. 4) Dr. Houston has applied to a series of soil washings, prepared from surface soils obtained from 15 different sources, and representing for his purposes flood waters of diverse origin, the bacterial tests which his previous researches had indicated as most likely to be useful for this purpose. These "soil waters," as Dr. Houston terms them, were the washings in each instance of a known weight of experimental soil diluted with sterile water. For most of the soils Dr. Houston employed two dilutions; in the first, the washings of one gramme of soil were contained in 1,000 cc.; in the second, the washings of the same quantity of soil were diluted to 100,000 cc. Out of the fifteen soils, eight had been chosen as typical of "virgin" soils; the remaining seven were all samples of soil which had been grossly contaminated by animal organic matter. Most of the latter soils were in fact taken from fields more or less recently irrigated by sewage.

In each instance the "soil waters" were tested, quantitatively, for the total number of bacteria and of the spores of aërobic bacteria, and, qualitatively, for the presence of bacillus coli, of streptococcus, and of spores of bacillus enteritidis sporogenes. Dr. Houston found, as from his previous researches might have been expected, that while the "polluted soil-waters" on the whole showed a larger total number of bacteria than the "virgin soil-waters," the distinction was by no means uniformly maintained. The total number of bacteria, in fact, was not a trustworthy index of the purity of the surface soil whence these waters had been derived. Determination of the total spores of aërobic bacteria had still less significance in this respect, these spores being present in relatively large numbers in all the "soil-waters."

Altogether different was the response to the three remaining, qualitative, tests. As regards the eight "virgin soil-waters," in no instance were bacillus coli or its close allies or any species of streptococcus detected; spores of bacillus enteritidis were in each instance absent from as much as 10 cc. of the 1 in 1,000 dilutions. Whereas, using correspondingly dilute, or even more dilute "soil-water," in the same, or even in less, amount, the seven "polluted soil-waters" proved to contain abundance of spores of bacillus enteritidis sporogenes in every case; bacillus coli or its close allies were present in four out of the seven samples; while in four instances also some streptococcus form was discovered.

By affirmative response to one or other, or to all, of these three tests, then, it would seem that unmistakeable evidence may be afforded that a given flood-water comprised the washings of surface soil at one or another time polluted with organic matter of animal outcome. Be it noted also that these tests are much more delicate than the customary chemical tests for organic matter in drinking water, which Dr. Houston has also, for the sake of comparison, carried out in the case of each "soil water," and that their delicacy may be greatly enhanced, as Dr. Houston shows, by filtration of the "soil water" through a Pasteur filter and subjecting the filter brushings to bacterial examination.

A negative response to these bacterial tests, it may be observed, would on this account seemingly possess greater significance than that which attaches to negative chemical results in like circumstances. Moreover, thanks to his previous studies of soil bacteriology, Dr. Houston has been able to show that by these qualitative bacterial tests something more may be learnt of the history of a flood-water. In surface soil spores of bacillus enteritidis apparently can persist with ease for months or even years; whereas bacillus coli, non-sporing, has difficulty in maintaining itself for far shorter periods, in recoverable and recognisable form. And as regards all varieties of streptococcus which he has studied in this relation, Dr. Houston has found reason to believe that in soil, as in water, they are still less capable of maintaining their existence than is bacillus coli. Wherefore he would infer that a flood-water which, out of his three tests, responded only to that for spores of bacillus enteritidis, may, with considerable confidence, be held to have been derived from surface soil much less recently, and therefore less dangerously, polluted by animal organic matter than another flood-water which, similarly tested, responded also in respect of bacillus coli and streptococcus.

Upon the more general question, as to means, that is, of detecting flood water, irrespective of its quality, present in a water supply, Dr. Houston affords also useful information. He is able to confirm his previous observation as to the liability of washings of surface soil to contain in exceptional abundance B. Mycoides (as bacilli and spores), Cladothrix, and the granular bacillus. Also he finds, as before, that in washings of surface soil spores of bacteria are, not only actually but relatively to the total bacterial flora, extremely abundant. By taking acconnt therefore of the indicia thus afforded no difficulty need be encountered in determining whether or not at a particular time a given water supply is being supplemented by storm washings from land surfaces in the vicinity of its source or sources.

TYPHOID BACILLUS IN SOIL.

Dr. Sidney Martin has continued his researches (Appendix B, No 5) into the ability of the typhoid bacillus to maintain itself in soils of differing qualities under diverse conditions of temperature moisture and the like.

First, he extended his experiments on growing, both in fluid media and in sterilised soil, one and another species of soil microbe in competition with the typhoid bacillus. He found that certain of these soil microbes, under the conditions of his experiments, have uniformly flourished, while the typhoid bacillus has slowly or quickly disappeared. On the other hand, others of these soil microbes in certain conditions failed to maintain themselves in competition with the typhoid micro-organism, and perished, whilst the typhoid bacillus survived. The temperature of experiment in these cases proved an important factor in the result.

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Next, he continued his investigations into the ability of the typhoid bacillus to live when added in pure culture to certain "natural" unsterilised soils, in each of which, when sterilised, it had been proved by experiment that the typhoid bacillus was capable of living for a great number of days.

Under the conditions of experiment described in last year's report, Dr. Martin had been unable to detect the typhoid bacillus when added to sundry unsterilised soils, 24 hours after the addition has been made; and this, notwithstanding that the same soils, sterilised, had proved capable of supporting the life of typhoid bacillus for periods of weeks, or even months. This year Dr. Martin used other soils and varied the conditions of experiment. Believing moisture of the experimental soil to have been specially inimical to typhoid bacillus, he this year experimented with soils kept much more dry than before. He also carried out his experiments at low temperatures. As a result, he has again found that the ability of the typhoid bacillus to maintain itself in soil is much greater, under the conditions of experiment, when the soil has been sterilised and the competition with other micro-organisms has been removed. But he has not now met with disappearance in 24 hours of typhoid bacillus from unsterilised soils; this bacillus has been recovered by him on sundry dates after its addition to the experimental soils up to a maximum of 12 days. In none, however, of the unsterilised soils, under any of the varying conditions of experiment, has there been evidence of any sustained multiplication of the typhoid bacillus. Nevertheless, from the relative abundance of the typhoid bacillus in the several unsterilised soils some days after the addition of this bacillus to them, Dr. Martin draws tentative conclusions as to the soil conditions which appear most to have favoured its survival.

These experiments seem to mark a distinct advance in our knowledge of the subject: firstly, a beginning has been made in understanding the conditions under which natural soil is capable of harbouring the typhoid bacillus; and, secondly, for these experiments Dr. Martin has adopted a method of isolating the typhoid bacillus from the crowd of other microbes present in natural soil which appears to give more satisfactory results than those which have formerly been employed.

SOIL AND ENTERIC FEVER.

In Chichester, where enteric fever may be considered endemic, we have known, from enquiries made for the Board by Dr. Theodore Thomson and others, enteric fever to recur year after year in certain areas of the town, whereas other and neighbouring areas, notwithstanding that their general sanitary conditions hardly differ from those of the "fever areas," have habitually escaped fever. Chichester therefore presented itself as a not unpromising field for testing bacterioscopically soil conditions of fever areas and of areas not prone to fever.

Dr. Houston's work in this connection last year (Appendix B, No. 6) was examination bacterioscopically and chemically of a number of soil samples from the vicinity of Chichester dwellings; dwellings similar (so far as could be judged) in all respects, save that some were in "fever areas," others in "non-fever areas." In this way it was hoped that indication might be directly obtained of conspicuous difference biologically of soil from the one and the other source.

Dr. Houston's experiments were directed solely to samples of soil, necessarily few in number, taken from the surface. They have been carefully and thoroughly pursued, but their results in the above sense are uniformly negative. Although he has added to our knowledge of the chemical and bacterial conditions of surface soil, Dr. Houston has not found any essential difference between soils from "fever" and "non-fever" areas in Chichester. Incidentally, however, he shows reason for suspecting that surface soil samples such as he examined are almost certain to be hostile to the existence of the typhoid bacillus, just as they are hostile to that common microbe of the intestinal tract—bacillus coli—which in certain biological aspects is comparable with the typhoid bacillus.

COCKLES AND SEWAGE.

In Appendix B, No. 7, Dr. Klein has recorded certain preliminary observations upon an investigation in which he is engaged with regard to the ability generally of cockles, from areas of the seashore obviously polluted by sewage, to retain in their interior living microbes of sewage, and, in particular, as to their ability to harbour living typhoid bacilli.

FOOD IN RELATION WITH PATHOGENIC BACTERIA.

Cows' milk has been shown beyond question to be capable of acting as a vehicle of the infective material of certain specific infectious diseases; as, for instance, tuberculosis, scarlatina, diphtheria, and enteric fever. In such case the infective material has gained access to the milk by way of diseased tissues of the body of the cow, or has been casually added to the milk in course of, or subsequent to, milking. For appreciation of the risk thus incurred by the human subject it is needful to regard milk not merely as a mechanical vehicle of pathogenic microbes recently reaching it, but also as possibly capable of supplying a pabulum for active multiplication of disease microbes. Similarly, it has to be borne in mind that sojourn in milk may enhance or inhibit the virulence of one and another pathogenic micro-organism.

Dr. Klein reports (Appendix B, No. 8) upon certain preliminary investigations made in the above direction upon the following microbes:—bacillus of tuberculosis, bacillus diphtheriæ, typhoid bacillus, and streptococcus scarlatinæ. In each instance he studied the behaviour of these micro-organisms in milk, cream, and cheese, sterilised for the purpose of experiment.

Tubercle bacillus.

Milk incubated at 37° C. serves, he finds, as a suitable medium for multiplication of tubercle bacilli, whether these are derived from laboratory cultures or from fresh tubercular deposits in the guinea pig. In the latter case milk cultures proved in each instance highly virulent. Glycerine agar cultures of tubercle bacilli, maintained for long periods of time in the laboratory, are, as is well known, apt slowly to part with, and ultimately to lose altogether, their ability to produce tuberculosis on inoculation into rodents. But when cultures in milk were made from such glycerine agar cultivations, and also when sub-cultures in milk were subsequently made from these milk cultures, Dr. Klein found in course of a considerable series of experiments that in each instance the tubercle bacilli had regained their pathogenicity and had become capable of producing tuberculosis on inoculation into the guineapig. But also he found reason to infer that the pathogenicity recovered in these circumstances is easily lost again. Upon sterilised cheese and in sterilised cream at 37° C. tubercle bacilli were found to thrive.

Typhoid bacillus.

The ability of the typhoid bacillus to grow luxuriantly in milk at temperatures such as 20° C. and 37° C. is well established, and was confirmed by Dr. Klein's recent experiments. On the other hand, cream proved a suitable medium for this bacillus only when it was kept at the lower of these two temperatures; at 37° C. the bacillus had in two weeks disappeared from the cream. At neither temperature was the typhoid bacillus recovered from sterilised cheese at the end of a like period.

Diphtheria bacillus.

Diphtheria bacilli from a recent and active agar culture were added to sterilised cream and cheese. From neither, however, whether at 20° C. nor at 37° C., was the bacillus recovered at the end of a fortnight. Milk at 37° C. was found similarly unsuitable to the vitality of the diphtheria bacillus, whereas in milk at 20° C. this bacillus grew typically and well.

Streptococcus scarlatinæ.

Scarlatina streptococcus, from a broth culture, was found to grow in milk at each of the above temperatures. After lapse of two weeks this streptococcus was recovered, though not in abundance, from cream and cheese kept at 20° C.; it could not be recovered in similar circumstances from either of these materials when incubated at 37° C.

BACTERIOLOGY OF CEREAL FOOD STUFF.

Instances of food poisoning have not unfrequently occurred in circumstances giving ground for suspicion that the causative agent has been a starchy food material; now and again, indeed, definite outbreaks of food poisoning have been referred, with considerable confidence, to food stuffs of this class. Occurrences of the sort in question might with advantage receive more detailed epidemiological investigation than has hitherto been accorded them. Meanwhile, looking to recent knowledge of food poisoning by "meat-preparations," it may be conjectured that illness caused by starch foods is probably related to the presence in such foods, or in the materials out of which they have been manufactured, of specific micro-organisms which within the animal body, or in course of their life-history in the food material, are capable of elaborating poisonous products.

As a condition, however, precedent to useful bacteriological investigation of the acquisition of poisonous properties by starch foods, we need knowledge (at present lacking) of the microbial conditions which normally or commonly obtain in the commercial raw material of these foods. In Appendix B, No. 9, Drs. Klein and Houston report upon preliminary investigation made to this end with twelve samples of wheat and oats, coming to market from various countries, and also with samples of rice, flour, and oatmeal purchased in London shops. Several drops of "washings" from the surface of the grains of wheat, oats, and rice in each instance were added to surface agar plates, and the resulting colonies were studied. Drs. Klein and Houston record the nature of the micro-organisms shown by this method to be habitually or occasionally present in the samples. Some of them, *e.g.*, bacillus subtilis, are well known, non-pathogenic, and almost ubiquitous bacteria. Others were found to be non-pathogenic microbes which appear specially associated with these starchy food stuffs; that most commonly met with being one or other variety of a bacillus provisionally named by these investigators "bacillus citreus cerealis."

In addition, search was in each instance made for spores of bacillus enteritidis sporogenes and for bacillus coli. Spores of the former bacillus were demonstrated to be present in each of the twelve samples of wheat and oats, and also in each of two samples of rice. In the majority of instances, however, as much as one gramme of the cereal or of the rice was needed for this demonstration. These spores were also discovered in one gramme of a particular sample of oatmeal; in another oatmeal sample and in each of two samples of flour they were not detected.

A similar search was made for bacillus coli. A bacillus which, as regards gas formation in gelatine shake culture, production of diffuse cloudiness in broth, clotting of milk and development of acidity therein, corresponded to typical bacillus coli, was found to be present in three out of the twelve samples of wheat and oats. In other five cases, sometimes only when as much as 1 gramme of the cereal was employed, bacilli were found to be present which, in morphological and cultural characters, showed close resemblance to "typical" bacillus coli, but which failed on subculture to respond to one or other of the tests which this microbe is called upon to satisfy. In certain samples of rice, oatmeal, and flour, used in as large quantities as one gramme, typical bacillus coli was found. In other samples of these three food stuffs neither bacillus coli nor allied bacilli were detected, even when as much as 1 gramme was used for experiment.

I have the honour to be,
Sir,
Your obedient Servant,
W. H. POWER.

6th November, 1900.

APPENDICES.

APPENDIX A.

APP. A, No. 1.

Digest of Vaccination Officers' Returns, 1897.

No. 1.

DIGEST of the VACCINATION OFFICERS' RETURNS with regard to Children whose Births were registered in the Year 1897.

The following is a summary of the twenty-sixth annual return under the Vaccination Act, 1871:—Of 927,518 births returned to the Board by the several vaccination officers in England and Wales as registered during the year 1897, the number which, at the time the return was made, had been registered as successfully vaccinated was 578,639 (being 62·4 per cent. of the whole), and the number registered as having died unvaccinated was 104,012 (or 11·2 per cent. of the whole). Of the remaining 244,867 children, 2,513 (or 0·3 per cent. of the whole) had been registered as insusceptible of vaccination; 1 case as having contracted small-pox; 14,454 (or 1·5 per cent.) as having their vaccination postponed by medical certificate; and 31,687 (or 3·4 per cent.) in respect of whom certificates of conscientious objection were received; leaving 196,212 (or 21·2 per cent.) as "removed," "not to be traced," or otherwise unaccounted for. If from the 927,518 births returned by these officers deduction be first made of the deaths that took place before vaccination, it it appears that, of the surviving 823,506 children, there were registered at the time of the return 70·3 per cent. as successfully vaccinated; 0·3 per cent. as either insusceptible of vaccination, or as having had small-pox; 1·8 per cent. as under medical certificate of postponement; and 3·8 per cent. in respect of whom certificates of conscientious objection to vaccination had been obtained; leaving 23·8 per cent. as at that time still unaccounted for as regards vaccination.

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Digest of Vaccination Officers' Returns, 1897.

The proportion of cases accounted for in the metropolitan returns for 1897 is 29·1 per cent.; in the provincial returns, 21·6. Of the registered births of the twenty-six years, 1872–97, the proportion not finally accounted for in regard to vaccination in each year respectively has been as follows:—

—	Metropolis.	Rest of England.	—	Metropolis.	Rest of England.
1872	8·8	4·5	1885	7·0	5·5
1873	8·7	4·2	1886	7·8	6·1
1874	8·8	4·1	1887	9·0	6·7
1875	9·3	3·8	1888	10·3	8·2
1876	6·5	4·0	1889	11·6	9·6
1877	7·1	4·1	1890	13·9	10·9
1878	7·1	4·3	1891	16·4	12·9
1879	7·8	4·5	1892	18·4	14·3
1880	7·0	4·5	1893	18·2	15·7
1881	5·7	4·3	1894	20·6	19·0
1882	6·6	4·5	1895	24·9	19·8
1883	6·5	4·9	1896	26·4	22·3
1884	6·8	5·3	1897	29·1	21·6

In 1897 the proportion of cases unaccounted for, after deduction of the postponed cases, in the Metropolis and in the rest of England, was 27·3 and 20·1 per cent. respectively.

—	Returns, 1897.								
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Number in respect of whom Certificates of conscientious objection have been received.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.
ENGLAND & WALES ..	927,518	578,639	2,513	1	104,012	31,687	14,454	196,212	22·7
Ditto (excluding Metropolitan Unions).	793,361	498,065	2,114	1	90,144	31,461	12,035	159,541	21·6
METROPOLITAN UNIONS ..	134,157	80,574	399	..	13,868	226	2,419	36,671	29·1
COUNTIES.									
ENGLAND:									
Bedford	4,428	332	1	..	578	675	7	2,835	64·2
Berks	7,014	4,988	11	..	642	49	110	1,214	19·0
Bucks	4,541	2,444	3	..	414	403	51	1,226	28·1
Cambridge	5,187	3,895	14	..	477	36	80	685	14·7
Chester	21,656	17,693	83	..	2,380	161	264	1,075	6·2
Cornwall	7,897	4,367	4	..	848	72	103	2,503	33·0
Cumberland	7,708	5,130	10	..	722	217	165	1,464	21·1
Derby	14,470	5,622	26	..	1,801	330	87	6,604	46·2
Devon	16,501	12,857	28	..	1,562	79	368	1,607	12·0
Dorset	4,885	3,455	11	..	370	34	50	965	20·8
Durham	39,607	26,035	115	..	4,745	598	687	7,427	20·5
Essex	27,930	17,596	76	..	2,635	414	857	6,352	25·8
Gloucester	23,097	11,100	53	..	2,302	1,536	878	7,228	35·1
Hereford	2,970	2,417	2	..	245	21	65	220	9·6
Hertford	6,949	4,504	12	..	554	305	112	1,462	22·7
Huntingdon	1,248	1,009	1	..	107	3	2	126	10·3
Kent (extra-metropolitan)	22,481	16,264	80	..	2,093	379	450	3,215	16·3
Lancaster	133,890	82,080	373	..	17,275	8,603	1,735	23,826	19·1
Leicester	12,793	647	..	..	1,944	2,309	6	7,887	61·7
Lincoln	13,329	6,871	29	..	1,664	1,630	352	2,783	23·5
Middlesex (ex.-metropolitan)	18,692	12,450	60	..	1,810	73	204	4,095	23·0
Monmouth	10,338	7,050	35	..	1,127	222	339	1,565	18·4
Norfolk	13,004	7,142	8	..	1,644	1,804	117	2,289	18·5
Northampton	9,774	1,907	2	..	1,084	2,157	29	4,595	47·3
Northumberland	18,053	12,087	43	..	2,265	208	194	3,256	19·1

—	Returns, 1897.								
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Number in respect of whom Certificates of conscientious objection have been received.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases, postponed), per cent. of births.
COUNTIES—*cont.*									
ENGLAND—*cont.*									
Nottingham	17,732	6,221	22	..	2,555	2,172	306	6,456	38·1
Oxford	4,730	3,193	7	..	400	382	49	705	15·9
Rutland	533	437	..	..	54	5	6	21	5·2
Salop	6,909	5,170	8	..	651	98	65	917	14·2
Somerset	11,649	7,138	19	..	1,029	479	280	2,704	25·6
Southampton	19,115	15,274	54	1	1,618	120	334	1,714	10·7
Stafford	34,933	18,587	116	..	4,930	306	393	10,591	31·5
Suffolk	9,713	6,988	20	..	823	205	114	1,563	17·3
Surrey (extra-metropolitan)	16,253	10,669	39	..	1,301	208	343	3,693	24·8
Sussex	13,748	8,923	31	..	1,221	502	279	2,792	22·3
Warwick	27,195	17,118	112	..	3,668	618	290	5,389	20·9
Westmorland	1,521	1,320	6	..	110	7	20	58	5·1
Wilts	6,632	2,930	7	..	554	1,008	118	2,015	32·2
Worcester	19,385	14,447	84	..	2,027	166	178	2,483	13·7
York, East Riding	13,323	9,712	63	..	1,519	350	160	1,519	12·6
York, North Riding.. ..	10,926	8,221	21	..	1,241	41	134	1,268	12·8
York, West Riding	78,875	49,981	350	..	9,686	2.439	737	15,682	20·8
WALES:									
Anglesey	868	723	..	..	82	..	7	56	7·3
Brecknock	1,538	1,147	2	..	147	4	37	201	15·5
Cardigan	1,482	1,240	..	..	131	1	27	83	7·4
Carmarthen	4,021	3,446	1	..	421	1	46	106	3·8
Carnarvon	3,298	2,652	4	..	343	3	58	238	9·0
Denbigh	2,945	2,404	4	..	326	2	68	141	7·1
Flint	2,484	2,070	1	..	251	1	51	110	6·5
Glamorgan	29,022	23,392	60	..	3,094	21	491	1,964	8·5
Merioneth	1,701	1,360	1	..	225	..	68	47	6·8
Montgomery	1,627	1,388	1	..	141	1	16	80	5·9
Pembroke	2,207	1711	1	..	239	2	35	219	11·5
Radnor	568	267	..	..	69	2	7	223	40·5

APP. A. No. 1.

Digest of Vaccination Officers' Returns, 1897.

METROPOLITAN UNIONS.	RETURNS, 1897.								
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Number in respect of whom Certificates of conscientious objection have been received.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.
Bethnal Green	4,849	687	3	..	679	5	13	3,462	71·7
Camberwell	7,510	4,161	18	..	783	15	43	2,490	33·7
Chelsea	2,569	2,022	13	..	239	7	29	259	11·2
Fulham	7,252	5,880	37	..	778	7	77	473	7·6
George, St., Hanover Square	2,641	2,208	11	..	264	5	20	133	5·8
George, St., in the East ..	2,037	1,155	1	..	164	..	24	693	35·2
Giles, St., and St. George ..	988	677	3	..	95	..	21	192	21·6
Greenwich	5,579	4,479	26	..	563	7	87	417	9·0
Hackney	7,188	1,540	13	..	589	9	10	5,028	70·1
Hampstead	1,480	1,182	17	..	115	4	42	120	10·9
Holborn	4,762	2,895	12	..	525	..	197	1,133	27·9
Islington	9,878	6,539	30	..	954	14	220	2,121	23·7
Kensington	3,694	2,859	13	..	335	5	87	395	13·0
Lambeth	9,413	5,703	27	..	1,044	23	230	2,386	27·8
Lewisham	2,666	1,553	7	..	256	5	2	843	31·7
London, City of	491	354	1	..	42	4	9	81	18·3
Marylebone	4,122	3,189	11	..	388	..	80	454	13·0
Mile End Old Town	4,296	1,129	3	..	447	9	143	2,565	63·0
Olave, St.	4,897	3,084	7	..	481	10	109	1,206	26·9
Paddington	3,039	2,461	10	..	262	6	31	269	9·9
Pancras, St.	7,036	5,132	17	..	711	1	263	912	16·7
Poplar	5,877	2,653	5	..	702	3	132	2,382	42·8
Saviour, St.	7,149	4,363	22	..	854	10	..	1,900	26·6
Shoreditch	4,337	823	6	..	583	2	3	2,920	67·4
Stepney	2,002	777	6	..	219	2	..	968	48·4
Strand	440	304	2	..	52	..	2	80	18·6
Wandsworth and Clapham ..	10,330	6,356	54	..	1,054	38	514	2,314	27·4
Westminster	758	604	..	..	66	1	1	86	11·5
Whitechapel	3,165	2,651	9	..	259	18	13	215	7·2
Woolwich	3,712	3,154	16	..	335	16	17	174	5·1
	134,157	80,574	399	..	13,868	226	2,419	36,671	29·1

	Returns, 1897.								
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-pox.	Died unvaccinated.	Number in respect of whom Certificates of conscientious objection have been received.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.
BEDFORD.									
Ampthill	368	43	1	..	31	109	2	182	50·0
Bedford	1,324	173	..	..	152	177	4	818	62·1
Biggleswade	736	35	..	..	82	1	..	608	83·6
Leighton Buzzard	439	17	..	..	67	244	..	111	25·3
Luton	1,358	26	..	..	212	67	1	1,052	77·5
Woburn	203	38	..	..	34	77	..	64	31·5
	4,428	332	1	..	578	675	7	2,835	64·2
BERKS.									
Abingdon	467	407	..	..	40	1	3	16	4·1
Bradfield	413	360	1	..	28	4	1	19	4·8
Easthampstead	359	279	..	..	23	3	..	54	15·0
Faringdon..	330	243	1	..	31	..	20	35	16·7
Hungerford and Ramsbury..	437	388	..	..	29	..	8	12	4·6
Maidenhead	578	368	1	..	56	25	7	121	22·1
Newbury	505	414	1	..	39	4	13	34	9·3
Reading	1,819	844	4	..	228	4	28	711	40·6
Wallingford	340	306	1	..	17	1	3	12	4·4
Wantage	426	364	..	..	35	6	8	13	4·9
Windsor	946	717	1	..	89	1	18	120	14·6
Wokingham	394	292	1	..	27	..	7	67	18·8
	7,014	4,982	11	..	642	49	116	1,214	19·0
BUCKINGHAM.									
Amersham	603	134	..	..	48	121	..	300	50·0
Aylesbury..	653	552	1	..	55	..	20	25	6·9
Buckingham	292	208	1	..	31	6	2	44	15·8
Eton..	864	718	1	..	65	6	15	59	8·6
Newport Pagnell	728	436	..	..	64	92	12	124	18·7
Winslow	169	11	..	..	24	83	..	51	30·2
Wycombe	1,232	385	..	..	127	95	2	623	50·7
	4,541	2,444	3	..	414	403	51	1,226	28·1
CAMBRIDGE.									
Cambridge	933	575	4	..	96	23	14	221	25·2
Caxton and Arrington ..	192	170	..	..	10	..	..	12	6·3
Chesterton	787	586	1	..	65	6	12	117	16·4
Ely	567	369	2	..	50	3	16	127	25·2
Linton	292	242	..	..	23	..	4	23	9·2
Newmarket	910	764	..	..	79	2	10	55	7·1
North Witchford	454	394	..	..	42	..	4	14	4·0
Whittlesey	191	168	3	..	15	..	2	3	2·6
Wisbech	861	627	4	..	97	2	18	113	15·3
	5,187	3,895	14	..	477	36	80	685	14·7

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CHESTER.									
Birkenhead	4,759	4,109	9	..	501	3	19	118	2·9
Bucklow	1,793	1,561	11	..	159	2	22	38	3·3
Chester	1,440	1,185	9	..	172	1	17	56	5·1
Congleton	958	771	4	..	82	6	41	54	9·9
Macclesfield	1,561	1,315	4	..	158	2	39	43	5·3
Nantwich	2,180	1,659	18	..	236	15	42	210	11·6
Northwich	2,023	1,814	2	..	176	..	8	23	1·5
Runcorn	1,212	1,057	4	..	126	..	15	10	2·1
Stockport	4,248	2,928	17	..	642	131	46	484	12·5
Tarvin	417	382	..	..	31	..	..	4	1·0
Wirral	1,065	912	5	..	97	1	15	35	4·7
	21,656	17,693	83	..	2,380	161	264	1,075	6·2
CORNWALL.									
Austell, St.	939	558	1	..	102	4	4	260	28·4
Bodmin	438	357	2	..	41	..	8	30	8·7
Camelford	204	174	..	..	14	2	6	8	6·9
Columb Major, St.	406	261	..	..	30	2	14	99	27·8
Falmouth	553	44	..	..	55	24	..	430	77·8
Germans, St.	404	349	..	..	37	..	1	17	4·5
Helston	542	328	..	..	72	..	18	124	26·2
Launceston	344	278	..	..	22	13	5	26	9·0
Liskeard	613	418	..	..	46	12	1	136	22·3
Penzance	1,214	811	1	..	136	4	12	250	21·6
Redruth	1,256	401	..	..	190	..	2	663	52·9
Stratton	178	133	..	..	15	..	2	28	16·9
Truro	816	255	..	..	88	11	30	432	56·6
	7,897	4,367	4	..	848	72	103	2,503	33·0
CUMBERLAND,									
Alston-with-Garrigill	72	56	..	..	12	1	3	..	4·2
Bootle	455	393	..	..	30	6	3	23	5·7
Brampton	236	156	..	..	21	1	22	36	21·2
Carlisle	1,749	1,437	1	..	176	4	82	49	7·5
Cockermouth	2,144	513	2	..	237	177	15	1,210	57·1
Longtown	161	138	1	..	5	..	2	15	10·6
Penrith	582	498	1	..	50	14	8	11	3·3
Whitehaven	1,710	1,432	5	..	153	5	26	89	6·7
Wigton	609	507	..	..	48	9	4	41	7·4
	7,708	5,130	10	..	722	217	165	1,464	21·1
DERBY.									
Ashbourne	568	418	..	..	45	7	3	95	17·3
Bakewell	863	600	2	..	78	14	6	163	19·6
Belper	2,154	1,049	4	..	268	179	11	643	30·4
Chapel-en-le-Frith	620	465	2	..	51	4	18	80	15·8
Chesterfield	4,545	2,144	10	..	558	6	22	1,805	40·2
Derby	2,826	145	1	..	430	10	..	2,240	79·3
Glossop	695	57	1	..	105	1	1	530	76·4
Hayfield	328	198	..	..	46	1	..	83	25·3
Shardlow	1,871	546	6	..	220	108	26	965	53·0
	14,470	5,622	26	..	1,801	330	87	6,604	46·2

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DEVON.									
Axminster	394	328	1	..	28	6	6	25	7·9
Barnstaple	1,058	880	..	..	78	19	33	48	7·7
Bideford	601	475	..	..	68	26	19	13	5·3
Crediton	414	356	1	..	35	..	5	17	5·3
Devonport	1,575	1,065	9	..	172	1	47	281	20·8
East Stonehouse	473	354	1	..	62	1	9	46	11·6
Exeter	906	676	..	..	99	..	40	91	14·5
Holsworthy	238	216	..	..	13	..	6	3	3·8
Honiton	466	422	..	..	33	..	1	10	2·4
Kingsbridge	438	378	2	..	35	..	3	20	5·3
Newton Abbot	1,734	1,495	3	..	147	1	29	59	5·1
Okehampton	370	308	..	..	24	4	7	27	9·2
Plymouth	2,778	1,638	3	..	362	7	25	743	27·6
Plympton St. Mary	667	483	..	..	77	2	6	99	15·7
South Molton	342	309	1	..	25	1	3	3	1·8
Tavistock	649	577	1	..	43	5	9	14	3·5
Thomas, St.	1,317	1,064	1	..	117	1	90	44	10·2
Tiverton	733	617	5	..	50	..	20	41	8·3
Torrington	299	267	..	..	19	1	2	10	4·0
Totnes	1,049	949	..	..	75	4	8	13	2·0
	16,501	12,857	28	..	1,562	79	368	1,607	12·0
DORSET.									
Beaminster	258	219	2	..	23	..	6	8	5·4
Blandford	290	198	..	..	18	3	1	70	24·5
Bridport	302	281	..	..	19	..	..	2	0·7
Cerne	118	104	..	..	6	3	3	2	4·2
Dorchester	471	362	1	..	46	1	6	55	13·0
Poole	881	460	4	..	84	17	15	301	35·9
Shaftesbury	314	253	..	..	23	6	5	27	10·2
Sherborne	291	237	2	..	22	..	1	29	10·3
Sturminster	225	207	..	..	14	1	..	3	1·3
Wareham and Purbeck	403	358	..	..	24	..	3	18	5·2
Weymouth	897	440	1	..	53	..	..	403	44·9
Wimborne and Cranborne	435	336	1	..	38	3	10	47	13·1
	4,885	3,455	11	..	370	34	50	965	20·8
DURHAM.									
Auckland	3,278	1,685	2	..	482	102	65	942	30·7
Chester-le-Street	2,160	1,715	4	..	255	1	42	143	8·6
Darlington	1,486	453	2	..	177	7	1	846	57·0
Durham	2,479	1,831	14	..	264	2	45	323	14·8
Easington	1,863	1,559	2	..	232	1	15	54	3·7
Gateshead	5,719	2,147	2	..	826	444	57	2,243	40·2
Hartlepool	2,655	2,153	23	..	265	4	40	171	7·9
Houghton-le-Spring	1,564	1,293	9	..	177	..	23	62	5·4
Lanchester	2,729	1,824	6	..	338	7	28	526	20·3
Sedgefield	783	672	2	..	88	..	4	17	2·7
South Shields	5,585	3,727	15	..	635	..	132	1,076	21·6
Stockton	2,047	1,680	5	..	219	..	31	112	7·0
Sunderland	6,202	4,603	28	..	689	..	182	697	14·2
Teesdale	603	312	1	..	59	22	15	194	34·7
Weardale	454	378	1	..	39	8	7	21	6·2
	39,607	26,035	115	..	4,745	598	687	7,427	20·5

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ESSEX.									
Billericay	457	367	..	..	40	2	14	34	10·5
Braintree	622	510	..	..	44	1	40	27	10·7
Chelmsford	890	746	..	..	67	4	..	73	8·2
Colchester	965	612	3	..	80	8	10	262	27·2
Dunmow	383	325	..	..	32	2	2	22	6·3
Epping	683	530	2	..	42	4	11	44	8·1
Halstead	376	317	1	..	26	8	5	19	6·4
Lexden and Winstree ..	556	472	2	..	30	..	8	44	9·4
Maldon	588	495	3	..	40	3	2	45	8·0
Ongar	259	203	..	..	20	..	1	35	13·9
Orsett	913	315	2	..	116	289	16	175	20·9
Rochford	1,214	613	3	..	119	46	46	387	35·7
Romford	2,254	1,420	1	..	262	12	76	483	24·8
Saffron Waldon	371	311	..	..	25	1	2	32	9·2
Tendring	1,189	954	3	..	105	10	16	101	9·8
West Ham	16,210	9,356	56	..	1,587	24	608	4,579	32·0
	27,930	17,596	76	..	2,635	414	857	6,352	25·8
GLOUCESTER.									
Barton Regis	6,012	3,404	16	..	596	97	406	1,493	31·8
Bristol	9,389	4,869	21	..	987	97	389	3,026	36·4
Cheltenham	1,225	291	5	..	135	85	2	707	57·9
Chipping Sodbury	383	238	1	..	26	..	18	100	30·8
Cirencester	478	384	2	..	45	5	5	37	8·8
Dursley	291	119	..	..	16	28	4	124	44·0
Gloucester	1,651	322	5	..	191	451	21	661	41·3
Newent	240	192	..	..	17	5	1	25	10·8
Northleach	188	165	1	..	10	1	2	7	4·8
Stow-on-the-Wold	236	160	..	..	18	10	7	41	20·3
Stroud	954	139	..	..	87	315	4	409	43·3
Tetbury	162	72	..	..	17	25	..	48	29·6
Tewkesbury	364	97	2	..	46	134	..	85	23·4
Thornbury	455	366	..	..	33	6	9	41	11·0
Westbury-on-Severn ..	690	18	..	..	52	254	..	366	53·0
Wheatenhurst	142	81	..	..	12	12	2	35	26·1
Winchcomb	239	183	..	..	14	11	8	23	13·0
	23,007	11,100	53	..	2,302	1,536	878	7,228	35·1
HEREFORD.									
Bromyard	281	216	..	..	27	5	6	27	11·7
Dore	188	130	..	..	19	..	12	27	20·7
Hereford	871	728	..	..	77	3	13	50	7·2
Kington	282	227	1	..	16	1	8	29	13·1
Ledbury	352	294	..	..	32	..	3	23	7·4
Leominster	358	299	..	..	20	..	11	19	8·4
Ross	429	350	1	..	33	12	12	21	7·7
Weobley	209	173	..	..	12	..	..	24	11·5
	2,970	2,417	2	..	245	21	65	220	9·6

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HERTS.									
Albans, St.	698	73	..	..	82	218	..	325	46·6
Barnet	1,304	853	3	..	96	10	40	302	26·2
Berkhampstead	436	300	..	..	53	23	14	46	13·8
Bishop Stortford	551	481	..	..	27	5	5	33	6·9
Buntingford	118	99	..	..	8	..	..	11	9·3
Hatfield	210	178	..	..	13	2	1	16	8·1
Hemel Hempstead	444	229	3	..	36	39	4	133	30·9
Hertford	423	380	1	..	18	1	6	17	5·4
Hitchin	655	557	2	..	65	..	..	31	4·7
Royston	382	329	1	..	27	1	2	22	6·3
Ware	502	414	1	..	30	1	10	46	11·2
Watford	1,174	565	1	..	97	5	30	476	43·1
Welwyn	52	46	..	..	2	..	..	4	7·7
	6,949	4,504	12	..	554	305	112	1,462	22·7
HUNTINGDON.									
Huntingdon	508	435	..	..	50	1	..	22	4·3
Ives, St.	372	335	1	..	26	1	2	7	2·4
Neots, St.	368	299	..	..	31	1	..	97	26·4
	1,248	1,009	1	..	107	3	2	126	10·3
KENT (Extra Metropolitan).									
Ashford, East	341	297	..	..	29	1	2	12	4·1
Ashford, West	486	374	..	..	29	16	10	57	13·8
Blean	539	455	2	..	42	4	6	30	6·7
Bridge	275	222	..	..	18	1	7	27	12·4
Bromley	1,910	1,243	6	..	174	5	49	433	25·2
Canterbury	511	377	1	..	45	..	1	87	17·2
Cranbrook	282	220	1	..	23	4	5	29	12·1
Dartford	2,333	1,841	6	..	266	9	26	185	9·0
Dover	1,137	688	4	..	114	1	27	303	29·0
Eastry	698	602	..	..	47	16	2	31	4·7
Elham	1,136	878	2	..	100	1	..	155	13·6
Faversham	722	624	4	..	76	1	5	12	2·4
Gravesend and Milton ..	697	447	3	..	62	3	2	180	26·1
Hollingbourn	327	254	..	..	32	..	3	38	12·5
Hoo	123	104	..	..	13	..	2	4	4·9
Maidstone	1,141	515	18	..	103	13	59	433	43·1
Malling	763	660	..	..	60	..	6	37	5·6
Medway	2,435	1,835	10	..	271	2	71	246	[illegible]
Milton	818	564	4	..	85	..	27	138	[illegible]
Romney Marsh	153	137	..	..	9	1	..	6	[illegible]
Sevenoaks	751	596	2	..	50	..	23	81	[illegible]
Sheppey	519	360	2	..	59	3	58	57	[illegible]
Strood	1,204	971	7	..	110	9	14	[illegible]	[illegible]
Tenterden	220	179	..	..	19	1	6	[illegible]	[illegible]
Thanet, Isle of	1,433	1,125	1	..	122	56	14	[illegible]	[illegible]
Tonbridge	1,518	696	7	..	135	232	26	[illegible]	[illegible]
	22,481	16,264	80	..	2,093	379	459	[illegible]	[illegible]

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LANCASTER.									
Ashton-under-Lyne	5,062	862	5	..	831	1,016	42	2,306	46·4
Barrow-in-Furness	1,587	1,329	4	..	174	8	17	55	4·5
Barton-upon-Irwell	2,788	1,613	7	..	321	10	..	837	30·0
Blackburn	6,391	4,404	26	..	783	140	141	897	16·2
Bolton	7,881	6,035	13	..	868	14	1	950	12·1
Burnley	5,984	873	26	..	736	1,168	26	3,155	53·2
Bury	3,744	773	3	..	650	1,244	23	1,042	28·4
Chorley	1,830	1,334	6	..	213	3	35	239	15·0
Chorlton	9,821	6,208	26	..	1,223	15	71	2,278	23·9
Clitheroe	572	409	..	..	49	12	15	87	17·8
Fylde, The	2,178	1,345	8	..	258	10	64	493	25·6
Garstang	297	248	2	..	32	3	2	10	4·0
Haslingden	2,954	1,404	5	..	443	550	70	482	18·7
Lancaster	1,605	1,326	2	..	144	5	46	82	8·0
Leigh	2,793	1,970	4	..	329	5	..	485	17·4
Liverpool	5,225	4,297	15	..	715	1	12	185	3·8
Lunesdale	186	141	..	..	13	1	5	26	16·7
Manchester	5,061	4,067	5	..	665	2	66	256	6·4
Oldham	5,899	175	..	..	1,032	2,498	..	2,194	37·0
Ormskirk	2.780	2,251	17	..	327	10	37	138	6·3
Prescot	5,471	4,333	11	..	678	4	34	411	8·1
Preston	4,618	2,971	16	..	777	19	46	789	18·1
Prestwich	5,523	3,723	18	..	564	6	113	1,099	21·9
Rochdale	2,948	284	..	..	414	1,354	8	888	30·4
Salford	7,728	4,980	32	..	1,132	10	220	1,354	20·4
Todmorden	1,002	180	..	..	116	405	5	296	30·0
Toxteth Park	4,169	2,970	25	..	526	1	298	349	15·5
Ulverston	1,074	955	1	..	78	2	17	21	3·5
Warrington	3,389	2,634	16	..	422	6	26	285	9·2
West Derby	16,373	13,246	62	..	1,861	2	247	955	7·3
Wigan	6,957	4,740	18	..	892	78	48	1,181	17·7
	133,890	82,080	373	..	17,275	8.602	1,735	23,825	19·1
LEICESTER.									
Ashby-de-la-Zouch	1,356	134	..	..	170	239	1	812	60·0
Barrow-on-Soar	710	15	..	..	85	325	2	289	40·6
Billesdon	[illegible]	84	..	..	10	13	2	17	15·1
Blaby	[illegible]	[illegible]	..	..	95	344	..	302	39·5
Hinckley	[illegible]	[illegible]	..	..	94	349	..	320	40·7
Leicester	[illegible]	[illegible]	..	..	[illegible]	2	..	4,982	79·9
Loughborough ..	[illegible]	[illegible]	..	..	[illegible]	513	1	214	2·3
Lutterworth ..	[illegible]	[illegible]	..	..	[illegible]	28	..	140	52·0
Market Bosworth	[illegible]	[illegible]	..	..	[illegible]	179	..	214	39·9
Market Harborou	[illegible]	[illegible]	..	..	[illegible]	..	..	462	97·1
Melton Mowbray	[illegible]	[illegible]	..	[illegible]	[illegible]	317	..	135	22·3
	[illegible]	[illegible]	..	[illegible]	[illegible]	2,309	6	7,887	61·7
Bo	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	51	25	423	41·3
Bo	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	15	3	94	18·8
O	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	14	8	22	7·4
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	455	1	275	25·8
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	539	30	149	13·6
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	32	16	66	8·9

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LINCOLN—*cont.*									
Grimsby	2,356	1,015	12	..	386	50	185	708	37·9
Holbeach	442	149	..	..	41	157	2	93	21·5
Horncastle	484	369	2	..	35	6	9	63	14·9
Lincoln	1,894	1,229	2	..	235	27	49	352	21·2
Louth	749	554	..	..	65	11	5	114	15·9
Sleaford	603	300	1	..	65	101	3	133	22·6
Spalding	551	82	..	..	52	171	12	234	44·6
Spilsby	531	452	1	..	48	1	3	26	5·5
Stamford	409	332	1	..	44	..	1	31	7·8
	13,329	6,871	29	..	1,664	1,630	352	2,783	23·5
MIDDLESEX (EXTRA METROPOLITAN).									
Brentford	4,464	3,593	22	..	393	..	..	456	10·2
Edmonton	8,486	4,793	9	..	860	63	120	2,641	32·5
Hendon	1,101	852	7	..	89	2	35	116	13·7
Staines	857	605	4	..	83	..	13	152	19·3
Uxbridge	919	769	1	..	88	2	7	52	6·4
Willesden	2,865	1,838	17	..	297	6	29	678	24·7
	18,692	12,450	60	..	1,810	73	204	4,095	23·0
MONMOUTH.									
Abergavenny	795	601	6	..	93	..	..	95	11·9
Bedwellty	2,928	1,664	1	..	303	2	165	793	32·7
Chepstow	539	349	..	..	53	38	10	89	18·4
Monmouth	833	437	..	..	79	158	12	147	19·1
Newport	3,801	2,977	24	..	440	21	101	238	8·9
Pontypool	1,442	1,022	4	..	159	3	51	203	17·6
	10,338	7,050	35	..	1,127	222	339	1,565	18·4
NORFOLK.									
Aylsham	501	423	..	..	43	3	2	30	6·4
Blofield	261	171	..	..	33	3	2	52	20·7
Depwade	549	452	1	..	34	7	17	38	10·0
Docking	463	400	..	..	35	3	5	20	5·4
Downham	502	395	2	..	68	..	8	29	7·4
Erpingham	594	434	..	..	49	20	8	83	15·3
Faith, St.	364	175	..	..	48	62	4	75	21·7
Flegg, East and West	320	250	..	..	44	6	8	12	6·2
Forehoe	272	193	..	..	28	4	1	46	17·3
Freebridge Lynn	339	298	1	..	24	3	2	11	3·8
Guiltcross	242	208	..	..	18	4	1	11	5·0
Henstead	271	198	..	..	21	8	1	43	16·2
King's Lynn	572	23	..	..	100	..	..	449	78·5
Loddon and Clavering	333	281	..	..	28	3	1	20	6·3
Mitford and Launditch	653	500	1	..	71	10	9	62	10·9
Norwich	3,370	226	1	..	644	1 572	4	923	27·5
Smallburgh	423	329	..	..	39	5	4	46	11·8
Swaffham	296	234	..	..	11	..	5	46	17·2
Thetford	464	395	..	..	35	10	7	17	5·2
Walsingham	486	388	..	..	48	13	4	33	7·6
Wayland	257	214	..	..	24	5	7	7	5·4
Yarmouth, Great	1,472	955	2	..	199	63	17	236	17·2
	13,004	7,142	8	..	1,644	1,804	117	2,289	18·5

App. A, No. 1.

Digest of Vaccination Officers' Returns, 1897.

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NORTHAMPTON.									
Brackley	299	134	1	..	36	24	..	104	34·8
Brixworth	293	48	..	..	13	73	..	159	54·3
Daventry	515	124	..	..	36	81	4	270	53·2
Hardingstone	301	62	..	..	46	127	2	64	21·9
Kettering	1,504	11	..	..	191	..	1	1,301	86·6
Northampton	2,592	60	..	..	314	1,177	4	1,037	40·2
Oundle	246	196	..	..	20	3	2	25	11·0
Peterborough	1,317	1,056	1	..	104	3	7	146	11·6
Potterspury	306	136	..	..	30	58	9	73	26·8
Thrapston..	416	30	..	..	43	161	..	182	43·8
Towcester..	277	36	..	..	30	94	..	117	42·2
Wellingborough..	1,708	14	..	..	221	356	..	1,117	65·4
	9,774	1,907	2	..	1,084	2,157	29	4,595	47·3
NORTHUMBERLAND.									
Alnwick	660	504	1	..	63	1	13	78	13·8
Belford	131	112	..	..	12	..	4	3	5·3
Bellingham	136	105	..	..	7	..	3	21	17·6
Berwick-upon-Tweed ..	546	458	..	..	70	..	3	15	3·3
Castle Ward	751	535	1	..	88	1	6	120	16·8
Glendale	184	167	..	..	11	..	..	6	3·3
Haltwhistle	234	67	1	..	21	62	2	81	35·5
Hexham	952	752	..	..	81	4	15	100	12·1
Morpeth	1,842	796	1	..	306	..	13	726	40·1
Newcastle-on-Tyne	7,298	5,274	25	..	889	26	29	1,055	14·9
Rothbury	151	133	1	..	16	..	1	..	0·7
Tynemouth	5,168	3,184	13	..	701	114	105	1,051	22·4
	18,053	12,087	43	..	2,265	208	194	3,256	19·1
NOTTINGHAM.									
Basford	6,182	1,502	5	..	869	1,030	79	2,697	44·9
Bingham	362	270	..	..	32	29	11	20	8·6
East Retford	669	557	3	..	51	11	4	43	7·0
Mansfield	2,736	859	5	..	413	22	30	1,407	52·5
Newark	802	627	4	..	59	19	13	80	11·6
Nottingham	5,336	1,163	2	..	963	1,045	121	2,042	40·5
Southwell	449	314	1	..	43	10	27	54	18·0
Worksop	1,196	929	2	..	125	6	21	113	11·2
	17,732	6,221	22	..	2,555	2,172	306	6,456	38·1
OXFORD.									
Banbury	729	100	..	..	66	310	..	253	34·7
Bicester	322	248	..	..	38	1	1	34	10·9
Chipping Norton	405	133	..	..	34	42	6	190	48·4
Headington	888	782	2	..	66	5	7	26	3·7
Henley	605	446	4	..	57	8	8	82	14·9
Oxford	609	516	1	..	55	1	6	30	5·9
Thame	317	274	..	..	24	11	8	30	11·0
Witney	506	432	..	..	37	3	11	23	6·7
Woodstock	325	262	..	..	23	1	2	37	12·0
	4,736	3,193	7	..	400	382	49	705	15·9

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RUTLAND.									
Oakham	233	213	..	..	24	2	6	8	4·9
Uppingham	240	194	..	..	30	3	..	13	5·4
	523	437	..	..	54	5	6	21	5·2
SALOP.									
Atcham	1,272	901	2	..	133	1	5	230	18·5
Bridgnorth	401	325	..	..	38	2	8	28	9·0
Church Stretton	124	113	..	..	7	1	..	3	2·4
Cleobury Mortimer	221	204	..	..	13	..	1	6	3·1
Clun	213	98	..	..	17	1	7	90	45·5
Drayton	361	326	1	..	27	1	2	4	1·7
Ellesmere	413	365	1	..	32	..	4	11	3·6
Ludlow	425	375	..	..	42	4	8	23	6·9
Madeley	675	574	1	..	53	2	16	29	6·7
Newport	388	315	..	..	38	..	7	28	9·0
Oswestry	808	677	3	..	83	..	..	45	5·6
Shifnal	264	183	..	..	30	49	2	..	0·8
Wellington	718	194	..	..	91	34	..	399	55·6
Wem	267	243	..	..	18	..	2	4	2·2
Whitchurch	329	277	..	..	29	3	3	17	6·1
	6,909	5,170	8	..	651	98	65	917	14·2
SOMERSET.									
Axbridge	1,014	229	1	..	88	270	9	417	42·0
Bath	1,742	989	1	..	174	6	133	439	32·8
Bridgwater	985	471	2	..	82	33	26	371	40·3
Chard	678	555	..	..	71	1	11	40	7·5
Clutton	777	460	..	..	58	16	12	231	31·3
Dulverton	119	106	..	..	11	..	1	1	1·7
Frome	511	332	2	..	37	26	3	111	22·3
Keynsham	1,060	445	..	..	105	8	25	477	47·4
Langport	345	277	..	..	24	..	8	36	12·8
Long Ashton	486	330	2	..	46	1	5	102	22·0
Shepton Mallet	374	240	..	..	22	58	2	52	14·4
Taunton	1,015	831	6	..	99	1	17	61	7·7
Wellington	468	379	1	..	36	16	2	34	7·7
Wells	568	360	1	..	63	8	7	129	23·9
Williton	382	340	..	..	27	1	4	10	3·7
Wincanton	386	293	3	..	26	5	7	52	15·3
Yeovil	739	501	..	..	60	29	8	141	20·2
	11,649	7,138	19	..	1,029	479	280	2,704	25·6
SOUTHAMPTON.									
Alresford	144	133	..	..	8	..	..	3	2·1
Alton	399	336	1	..	24	..	6	32	9·5
Alverstoke	752	649	2	..	77	..	5	19	3·2
Andover	367	265	..	..	28	16	9	49	15·8
Basingstoke	551	365	1	..	40	13	11	121	24·0
Catherington	78	65	..	1	5	..	1	6	9·0
Christchurch	1,321	698	5	..	107	8	31	472	38·1
Droxford	280	249	..	..	21	..	4	6	3·6
Fareham	529	465	..	..	44	..	3	17	3·8
Fordingbridge	191	164	..	..	12	1	..	14	7·3

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SOUTHAMPTON—*cont.*									
Hartley Wintney	711	551	2	..	55	6	24	73	13·6
Havant	255	224	..	..	18	..	6	7	5·1
Hursley	101	88	..	..	4	..	3	6	8·9
Kingsclere	237	210	..	..	20	..	..	7	3·0
Lymington	276	205	..	..	21	..	2	48	18·1
New Forest	333	274	..	..	15	..	3	30	10·2
Petersfield	294	254	1	..	14	2	5	18	7·8
Portsea Island	4,924	4,303	22	..	473	1	31	94	2·5
Ringwood	153	125	1	..	14	..	4	9	8·5
Romsey	264	225	..	..	17	2	8	12	7·6
Southampton	1,886	1,552	15	..	189	3	21	106	6·7
South Stoneham	2,059	1,578	2	..	168	2	69	240	15·0
Stockbridge	179	160	..	..	9	2	2	6	4·5
Whitchurch	174	140	..	..	17	..	10	7	9·8
Wight, Isle of	1,903	1,364	2	..	145	60	66	266	17·4
Winchester, New	765	632	..	..	73	4	10	46	7·3
	19,115	15,274	54	1	1,618	120	334	1,714	10·7
STAFFORD.									
Burton-upon-Trent	2,667	1,003	3	..	321	8	1	1,332	50·0
Cannock	1,558	1,175	5	..	145	19	13	201	13·7
Cheadle	708	594	1	..	54	1	6	52	8·2
Leek	1,259	941	1	..	140	101	28	48	6·0
Lichfield	1,229	1,060	7	..	117	..	17	28	3·7
Newcastle-under-Lyme	1,306	1,151	4	..	136	..	4	11	1·1
Seisdon	432	284	2	..	54	5	2	85	20·1
Stafford	798	650	..	..	68	5	19	56	9·4
Stoke-upon-Trent	5,387	3,873	13	..	854	5	73	569	11·9
Stone	514	414	..	..	52	1	14	33	9·1
Tamworth	682	374	1	..	86	23	8	190	29·0
Uttoxeter	414	305	..	..	46	..	2	61	15·2
Walsall	3,921	1,607	29	..	651	21	30	1,583	41·1
West Bromwich	5,215	1,011	10	..	771	..	86	3,337	65·6
Wolstanton and Burslem	3,455	2,578	4	..	520	4	3	346	10·1
Wolverhampton	5,378	1,568	36	..	915	113	87	2,659	51·0
	34,923	18,587	116	..	4,930	306	393	10,591	31·5
SUFFOLK.									
Blything	671	604	1	..	44	1	5	16	3·1
Bosmere and Claydon	393	331	..	..	32	3	9	18	6·9
Bury St. Edmunds	437	353	..	..	39	..	25	20	10·3
Cosford	424	376	..	..	26	4	5	13	4·2
Hartismere	365	292	..	..	33	5	1	34	9·6
Hoxne	330	288	..	..	25	2	1	14	4·5
Ipswich	1,762	309	2	..	206	152	..	1,093	62·0
Mildenhall	241	208	..	..	19	1	4	9	5·4
Mutford and Lothingland	1,192	916	4	..	100	8	21	143	13·8
Plomesgate	491	419	1	..	35	6	6	24	6·1
Risbridge	495	427	2	..	36	2	7	21	5·7
Samford	329	285	3	..	28	4	3	6	2·7
Stow	554	470	1	..	43	11	8	21	5·2
Sudbury	628	516	2	..	41	2	5	62	10·7
Thingoe	392	341	..	..	34	3	6	8	3·6
Wangford	379	329	1	..	38	..	3	8	2·9
Woodbridge	630	524	3	..	44	1	5	53	9·2
	9,713	6,988	20	..	823	205	114	1,563	17·5

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SURREY (EXTRA METROPOLITAN).									
Chertsey	910	623	1	..	64	4	9	209	24·0
Croydon	4,357	2,054	4	..	390	23	97	1,789	43·3
Dorking	367	205	..	..	22	55	5	80	23·2
Epsom	1,176	815	4	..	103	26	26	202	19·4
Farnham	1,865	1,423	3	..	154	2	5	278	15·2
Godstone	558	381	..	..	36	3	5	130	24·2
Guildford	1,438	919	4	..	107	77	32	269	20·9
Hambledon	470	403	1	..	37	2	7	20	5·7
Kingston	3,100	2,334	16	..	226	..	117	407	16·9
Reigate	937	535	2	..	71	14	31	284	33·6
Richmond..	1,075	944	4	..	91	2	9	25	3·2
	16,253	10,669	39	..	1,301	208	343	3,093	24·8
SUSSEX.									
Battle	529	279	..	..	44	..	16	190	38·9
Brighton	2,605	1,837	5	..	314	2	93	354	17·2
Chichester	297	256	1	..	23	..	2	15	5·7
Cuckfield	583	457	1	..	33	11	11	70	13·9
Eastbourne	1,062	164	..	..	99	104	7	688	65·4
East Grinstead	434	116	..	..	52	10	..	256	59·0
East Preston	830	681	2	..	58	..	45	44	10·7
Hailsham	391	280	1	..	24	23	5	58	16·1
Hastings	1,377	909	3	..	108	29	1	327	23·8
Horsham	656	513	5	..	59	13	14	52	10·1
Lewes	528	152	1	..	42	123	9	201	39·8
Midhurst	346	295	1	..	27	2	9	12	6·1
Newhaven	290	208	1	..	25	13	6	37	14·8
Petworth	204	185	..	..	12	..	1	6	3·4
Rye	271	188	..	..	30	27	5	21	9·6
Steyning	1,643	1,323	9	..	146	1	34	130	10·0
Thakeham	172	155	..	..	12	..	1	4	2·9
Ticehurst	385	270	..	..	25	21	2	67	17·9
Uckfield	544	153	..	..	46	120	..	225	41·4
Westbourne	185	153	1	..	16	..	..	15	8·1
Westhampnett	416	349	..	..	26	3	18	20	9·1
	13,748	8,923	31	..	1,221	502	279	2,792	22·3
WARWICK.									
Alcester	550	434	..	..	46	13	6	51	10·4
Aston	9,979	7,043	55	..	1,424	6	221	1,230	14·5
Atherstone	619	219	..	..	82	28	1	289	46·8
Birmingham	8,297	6,263	44	..	1,240	5	27	718	9·0
Coventry	1,928	135	2	..	301	384	..	1,106	57·4
Foleshill	793	315	..	..	89	66	2	321	40·7
Meriden	264	192	2	..	22	2	3	43	17·4
Nuneaton	872	57	..	..	155	44	..	616	70·6
Rugby	870	142	..	..	70	30	1	627	72·2
Solihull	1,014	740	3	..	78	5	3	185	18·5
Southam	280	194	..	..	26	10	2	48	17·9
Stratford-on-Avon	502	388	..	..	44	24	2	44	9·2
Warwick	1,227	996	6	..	91	1	22	111	10·8
	27,195	17,118	112	..	3,668	618	290	5,389	20·9

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WESTMORLAND.									
East Ward	322	253	1	..	33	5	1	29	9·3
Kendal	1,001	896	5	..	58	2	18	22	4·0
West Ward	198	171	..	..	19	..	1	7	4·0
	1,521	1,320	6	..	110	7	20	58	5·1
WILTS.									
Amesbury	159	124	..	..	14	..	3	18	13·2
Bradford	215	95	..	..	17	16	1	86	40·5
Calne	220	74	..	..	19	29	14	84	44·5
Chippenham	550	192	..	..	29	..	5	324	59·8
Cricklade & Wootton Bassett	312	32	1	..	24	82	..	173	55·4
Devizes	478	235	..	..	29	88	6	120	26·4
Malmesbury	321	203	1	..	29	18	9	61	21·8
Marlborough	204	182	1	..	12	2	1	6	3·4
Mere	152	127	..	..	12	..	5	8	8·6
Pewsey	275	237	1	..	17	..	2	18	7·3
Salisbury	683	551	..	..	51	16	10	55	9·5
Swindon and Highworth ..	1,677	164	1	..	186	568	46	712	45·2
Tisbury	198	173	..	..	13	..	7	5	6·1
Trowbridge and Melksham ..	430	45	2	..	35	148	..	200	46·5
Warminster	279	208	..	..	20	20	1	30	11·1
Westbury and Whorwellsdown.	239	93	..	..	28	9	..	109	45·6
Wilton	240	195	..	..	19	12	8	6	5·8
	6,632	2,930	7	..	554	1,008	118	2,015	32·2
WORCESTER.									
Bromsgrove	927	793	4	..	83	..	9	38	5·1
Droitwich	476	390	1	..	40	..	4	41	9·5
Dudley	5,570	4,111	20	..	646	7	48	739	13·9
Evesham	523	381	1	..	36	70	6	29	6·7
Kidderminster	1,014	882	6	..	90	5	3	28	3·1
King's Norton	4,634	2,868	29	..	522	69	17	1,129	25·7
Martley	445	365	2	..	32	..	3	43	10·3
Pershore	351	316	1	..	20	1	4	9	3·7
Shipston-on-Stour	383	291	3	..	38	6	6	39	11·7
Stourbridge	3,071	2,675	6	..	291	5	39	55	3·1
Tenbury	190	147	..	..	23	1	7	12	10·0
Upton-on-Severn	524	453	1	..	38	1	8	24	6·1
Worcester	1,277	776	1	..	168	1	24	307	25·9
	19,385	14,447	84	..	2,027	166	178	2,483	13·7
YORK, EAST RIDING.									
Beverley	708	585	3	..	73	4	5	38	6·1
Bridlington	501	343	3	..	48	3	..	104	20·8
Driffield	513	424	3	..	43	1	1	41	8·2
Howden	352	287	..	..	42	..	..	23	6·5
Kingston-upon-Hull	2,559	1,538	23	..	316	36	27	619	25·2
Patrington	193	166	..	..	17	2	..	8	4·1
Pocklington	418	364	1	..	33	..	10	10	4·8
Sculcoates	5,262	3.760	18	..	594	302	72	516	11·2
Skirlaugh	231	198	..	..	20	..	1	12	5·6
York	2,586	2.047	12	..	333	2	44	148	7·4
	13,323	9,712	63	..	1,519	350	160	1,519	12·6

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YORK, North Riding.									
Aysgarth	114	99	..	..	12	..	2	1	2·6
Bedale	201	171	1	..	20	..	1	8	4·5
Easingwold	242	204	..	..	26	..	1	11	5·0
Guisborough	1,290	1,028	2	..	150	..	28	82	8·5
Helmsley	117	104	1	..	2	..	..	10	8·5
Kirkby Moorside	141	121	..	..	13	..	1	6	5·0
Leyburn	154	133	..	..	14	..	1	6	4·5
Malton	540	397	..	..	62	10	11	60	13·1
Middlesbrough	4.601	3,836	13	..	542	4	49	157	4·5
Northallerton	316	271	..	..	34	..	2	9	3·5
Pickering	333	239	1	..	46	12	16	19	10·5
Reeth	68	60	..	..	1	..	1	6	10·3
Richmond	335	258	..	..	41	2	5	29	10·1
Scarborough	1,280	281	2	..	165	7	2	823	64·5
Stokesley	309	264	..	..	29	..	8	8	5·2
Thirsk	326	294	..	..	26	..	1	5	1·8
Whitby	559	461	1	..	58	6	5	28	5·9
	10,926	8,221	21	..	1,241	41	134	1,268	12·8
YORK, West Riding.									
Barnsley	4,315	3,180	41	..	580	8	36	470	11·7
Bierley, North	3,593	1,875	18	..	391	126	45	1,138	32·9
Bradford	5,360	2,353	10	..	791	46	42	2,118	40·3
Bramley	2,371	1,547	10	..	283	4	41	486	22·2
Dewsbury	4,848	1,023	10	..	843	..	55	2,917	61·3
Doncaster	2,626	1,844	13	..	348	48	21	352	14·2
Ecclesall Bierlow	4,995	4,125	55	..	559	16	60	180	4·8
Goole	849	636	1	..	98	1	12	101	13·3
Halifax	4,490	199	..	..	583	166	..	3,542	76·7
Hemsworth	777	553	3	..	102	3	16	100	14·9
Holbeck	1,084	855	·2	..	156	1	11	59	6·5
Huddersfield	4,038	3,556	12	..	329	7	3	131	3·3
Hunslet	2,747	2,160	7	..	370	4	86	120	7·5
Keighley	1,954	94	..	..	137	1,083	1	639	32·8
Knaresborough	889	353	2	..	101	21	18	394	46·3
Leeds	7,447	5,964	35	..	899	13	77	459	7·2
Ouseburn, Great	251	222	..	..	18	1	3	7	4·0
Pateley Bridge	254	167	..	..	22	3	1	61	24·4
Penistone	480	415	..	..	32	4	10	19	6·0
Pontefract	2,591	2,095	16	..	302	5	11	162	6·7
Ripon	379	296	..	..	29	2	5	47	13·7
Rotherham	3,753	3,083	11	..	401	4	18	236	6·8
Saddleworth	424	70	..	..	56	228	1	69	16·5
Sedbergh	80	75	1	..	4	..	..	..	0·0
Selby	429	372	..	..	42	..	4	11	3·5
Settle	346	221	..	..	33	20	7	65	20·8
Sheffield	7.935	6,008	71	..	1,087	20	58	691	9·4
Skipton	1,195	221	1	..	157	544	10	262	22·8
Tadcaster	988	818	4	..	98	2	6	60	6·7
Thorne	419	307	..	..	31	10	9	62	16·9
Wakefield	3,544	2,772	14	..	434	7	23	294	8·9
Wetherby	360	319	2	..	30	..	5	4	2·5
Wharfedale	1,449	907	3	..	174	41	19	305	22·4
Wortley	1,615	1,296	8	..	166	1	23	121	8·9
	75,875	49,981	350	..	9,686	2,439	737	15,682	20·8

—	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-Pox.	Died unvaccinated.	Number in respect of whom Certificates of conscientious objection have been received.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.
	RETURNS, 1897.								
ANGLESEY.									
Anglesey	345	297	..	..	41	..	2	5	2·0
Holyhead	523	426	..	..	41	..	5	51	10·7
	868	723	..	..	82	..	7	56	7·3
BRECKNOCK.									
Brecknock	418	357	..	..	46	..	5	10	3·6
Builth	230	181	1	..	22	..	6	10	7·3
Crickhowell	673	456	1	..	55	1	19	141	23·8
Hay	227	153	..	..	24	3	7	40	20·7
	1,538	1,147	2	..	147	4	37	201	15·5
CARDIGAN.									
Aberayron	246	209	..	..	26	..	4	7	4·5
Aberystwith	504	421	..	..	47	1	19	16	6·9
Cardigan	334	248	..	..	28	..	1	57	17·4
Lampeter	221	200	..	..	19	..	2	..	0·9
Tregaron	177	162	..	..	11	..	1	3	2·3
	1,482	1,240	..	..	131	1	27	83	7·4
CARMARTHEN.									
Carmarthen	871	772	1		83	..	7	8	1·7
Llandilo Fawr	693	504	..	..	83	..	5	11	2·3
Llandovery	352	231	.	..	25	..	3	3	2·4
Llanelly	1,768	1,484	..	..	184	1	27	72	5·6
Newcastle-in-Emlyn	437	375	..	..	46	..	4	12	3·7
	4,021	3,446	1	..	421	1	46	106	3·8
CARNARVON.									
Bangor and Beaumaris ..	997	852	1	..	108	2	6	28	3·4
Carnarvon	1,096	813	..	..	106	..	23	154	16·1
Conway	711	575	1	..	87	..	..	48	6·8
Pwllheli	494	412	2	..	42	1	29	8	7·5
	3,298	2,652	4	..	343	3	58	238	9·0
DENBIGH.									
Llanrwst	309	241	..	..	28	1	18	21	12·6
Ruthin	275	229	2	..	32	..	5	7	4·4
Wrexham	2,361	1,934	2	..	266	1	45	113	6·7
	2,945	2,404	4	..	326	2	68	141	7·1

APP. A, No. 1.

Digest of Vaccination Officers' Returns, 1897

—	RETURNS, 1897.								
	Births.	Successfully Vaccinated.	Insusceptible of Vaccination.	Had Small-Pox.	Died unvaccinated.	Number in respect of whom Certificates of conscientious objection have been received.	Vaccination postponed.	Remaining.	Children not finally accounted for (including cases postponed), per cent. of births.
FLINT.									
Asaph, St.	721	578	..	..	87	..	6	50	7·8
Hawarden	558	484	1	..	37	..	14	22	6·4
Holywell	1,205	1,008	..	..	127	1	31	38	5·7
	2,484	2,070	1	..	251	1	51	110	6·5
GLAMORGAN.									
Bridgend and Cowbridge ..	2,114	1,731	5	..	220	2	59	97	7·4
Cardiff	7,404	5,722	29	..	736	14	34	869	12·2
Gower	308	243	..	..	26	..	..	39	12·7
Merthyr Tydfil	4,805	3,879	5	..	556	..	286	79	7·6
Neath	2,404	2,062	6	..	252	1	27	56	3·5
Pontardawe	919	797	..	..	90	..	20	12	3·5
Pontypridd	7,326	5,817	13	..	876	4	64	552	8·4
Swansea	3,742	3,141	2	..	338	..	1	260	7·0
	29,022	23,392	60	..	3,094	21	491	1,964	8·5
MERIONETH.									
Bala	119	90	..	..	16	..	10	3	10·9
Corwen	412	326	..	..	45	..	24	17	10·0
Dolgelley	315	269	..	..	38	..	5	3	2·5
Festiniog	855	675	1	..	126	..	29	24	6·2
	1,701	1,360	1	..	225	..	68	47	6·8
MONTGOMERY.									
Forden	378	308	..	..	41	..	3	26	7·7
Llanfyllin	436	396	..	..	31	1	4	4	1·8
Machynlleth	264	222	..	..	30	..	5	7	4·5
Newtown and Llanidloes ..	549	462	1	..	39	..	4	43	8·6
	1,627	1,388	1	..	141	1	16	80	5·9
PEMBROKE.									
Haverfordwest	934	621	1	..	117	1	8	186	20·8
Narberth	432	382	..	..	34	..	7	9	3·7
Pembroke	841	708	..	..	88	1	20	24	5·2
	2,207	1,711	1	..	239	2	35	219	11·5
RADNOR.									
Knighton	315	96	..	..	41	..	7	171	56·5
Rhayader	253	171	..	..	28	2	..	52	20·6
	568	267	..	..	69	2	7	223	40·5

No. 2.

App. A, No. 2.

Inspection of Vaccination, and Awards to Public Vaccinators, 1899.

LIST (alphabetically arranged) of 286 UNIONS inspected during the Year 1899, with reference to the PROCEEDINGS under the VACCINATION ACTS, 1867 to 1898, and an ACCOUNT of the AWARDS certified by the Board as payable to the respective PUBLIC VACCINATORS out of COUNTY FUNDS.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union.		Total Sum awarded in each Union.	Medical Inspector.
			Minimum.	Maximum.		
			£ s. d.	£ s. d.	£ s. d.	
Alresford	2	2	2 16 0	4 2 0	6 18 0	Dr. Bulstrode.
Alton	4	3	2 8 0	3 9 0	8 12 0	Do.
Amersham	6	4	1 16 0	3 11 0	9 14 0	„ Fletcher.
Amesbury	2	2	4 8 0	9 13 0	14 1 0	„ Johnstone.
Ampthill	4	2	1 1 0	1 15 0	2 16 0	„ Fletcher.
Ashbourne	6	5	1 16 0	15 5 0	33 9 0	„ Buchanan.
Ashford, East	7	2	1 19 0	2 5 0	4 4 0	„ Sweeting.
Ashford, West	4	4	1 13 0	11 9 0	21 15 0	Do.
Atcham	7	4	3 7 0	8 10 0	21 5 0	„ Reece.
Austell, St.	5	2	4 5 0	7 3 0	11 8 0	Mr. Royle.
Axbridge	11	6	0 13 0	4 7 0	12 17 0	Do.
Aylesbury	8	6	1 12 0	14 18 0	31 12 0	Dr. Fletcher.
Aysgarth	2	2	2 17 0	4 16 0	7 13 0	„ Buchanan.
Bakewell	8	7	1 17 0	7 11 0	32 14 0	Dr. Buchanan.
Bala	1	—	—	—	—	„ Wheaton.
Bangor and Beaumaris.	6	3	5 6 0	6 18 0	18 3 0	Do.
Barnsley	6	2	11 3 0	18 13 0	29 16 0	„ Johnstone.
Barrow-in-Furness ..	1	1	—	—	76 6 0	„ Fletcher.
Barton Regis	2	2	4 4 0	11 0 0	15 4 0	„ Mivart.
Basford	16	15	1 11 0	23 15 0	118 18 0	„ Darra Mair.
Basingstoke	8	7	0 10 0	4 14 0	15 2 0	Mr. Royle
Bath	5	4	2 7 0	17 0 0	32 14 0	Do.
Beaminster	6	3	1 5 0	6 5 0	11 2 0	Do.
Bedale	4	3	1 9 0	5 19 0	11 6 0	Dr. Buchanan.

APP. A, No. 2.

Inspection of Vaccination, and Awards to Public Vaccinators, 1899.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union.		Total Sum awarded in each Union.	Medical Inspector.
			Minimum.	Maximum.		
			£ s. d.	£ s. d.	£ s. d.	
Bedford	8	6	0 5 0	2 8 0	7 15 0	Dr. Fletcher.
Belper	9	7	2 8 0	11 15 0	56 9 0	„ Buchanan.
Bethnal Green ..	2	1	—	—	51 15 0	„ Sweeting.
Beverley	6	3	1 6 0	18 6 0	22 8 0	„ Johnstone.
Biggleswade	6	6	0 10 0	1 14 0	7 5 0	„ Fletcher.
Bingham	4	4	3 10 0	5 17 0	17 6 0	„ Darra Mair.
Birkenhead	3	3	12 7 0	78 7 0	104 4 0	„ Wheaton.
Birmingham (L.A.) ..	1	1	—	—	286 4 0	„ Bruce Low.
Blackburn	10	9	0 3 0	17 11 0	55 10 0	„ Fletcher.
Blandford	5	5	0 5 0	6 14 0	12 12 0	Mr. Royle.
Blean	4	4	3 17 0	8 14 0	25 0 0	Dr. Sweeting.
Blything	8	8	2 13 0	9 1 0	43 5 0	„ Copeman.
Bodmin	8	4	1 17 0	4 4 0	12 5 0	Mr. Royle.
Bosmere and Claydon	3	2	7 11 0	11 18 0	19 9 0	Dr. Copeman.
Brecknock	3	3	5 16 0	12 12 0	25 17 0	„ Bulstrode.
Bridge	5	4	1 2 0	5 2 0	12 9 0	„ Sweeting.
Bridgend and Cowbridge.	7	4	11 12 0	34 10 0	91 5 0	„ Johnstone.
Bridgwater	10	4	2 14 0	8 7 0	20 8 0	Mr. Royle.
Bridgnorth	3	2	1 16 0	5 9 0	7 5 0	Dr. Reece.
Bridlington	4	2	1 7 0	5 16 0	7 3 0	„ Johnstone.
Bridport	3	2	2 12 0	13 15 0	16 7 0	Mr. Royle.
Brighton	2	2	28 3 0	36 9 0	64 12 0	Dr. Reece.
Bristol (L.A.)	8	3	4 1 0	9 9 0	21 18 0	„ Bruce Low.
Bromley	9	6	1 0 0	6 14 0	22 13 0	„ Sweeting.
Buckingham	3	2	4 14 0	5 14 0	10 8 0	„ Fletcher.
Builth	1	1	—	—	14 5 0	„ Bulstrode.
Burnley	7	3	0 8 0	12 18 0	15 10 0	„ Wheaton.
Burton-on-Trent ..	8	8	0 16 0	21 9 0	59 9 0	Do.
Bury	6	6	3 18 0	18 4 0	47 19 0	Do.
Bury St. Edmund's ..	1	—	—	—	—	„ Copeman.
Camberwell	5	4	33 4 0	47 0 0	165 8 0	Dr. Sweeting.
Camelford	2	2	4 18 0	10 5 0	15 3 0	Mr. Royle,
Cannock	9	3	0 17 0	6 12 0	8 9 0	Dr. Wheaton.
Canterbury	1	1	—	—	11 15 0	„ Sweeting.
Cardiff	9	7	0 18 0	47 12 0	131 10 0	„ Bruce Low.

APP. A, No. 2.

Inspection of Vaccination, and Awards to Public Vaccinators, 1899.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union.		Total Sum awarded in each Union.	Medical Inspector.
			Minimum.	Maximum.		
			£ s. d.	£ s. d.	£ s. d.	
Cardigan	3	3	6 15 0	7 17 0	22 7 0	Dr. Darra Mair.
Carmarthen	6	5	4 3 0	16 14 0	51 15 0	„ Bulstrode.
Carnarvon	7	3	2 11 0	20 11 0	27 8 0	„ Wheaton.
Cerne	3	3	0 18 0	4 13 0	9 10 0	Mr Royle.
Chapel-en-le-Frith ..	3	2	12 4 0	12 13 0	24 17 0	Dr. Buchanan.
Chard	8	6	1 3 0	18 11 0	48 16 0	Mr. Royle.
Cheadle	5	3	6 7 0	9 3 0	23 11 0	Dr. Wheaton.
Chelsea	2	2	23 16 0	54 11 0	77 7 0	„ Sweeting.
Chertsey	6	6	0 14 0	6 9 0	23 8 0	„ Thomson.
Chipping Sodbury ..	5	2	3 9 0	10 4 0	13 13 0	„ Mivart.
Christchurch	3	3	4 8 0	9 1 0	19 9 0	„ Bulstrode.
Cirencester	5	5	0 10 0	8 11 0	25 4 0	„ Mivart.
Clitheroe	5	3	2 19 0	4 7 0	10 10 0	„ Wheaton.
Clutton	5	5	3 2 0	7 7 0	26 19 0	Mr. Royle.
Columb, St., Major ..	6	6	1 12 0	4 1 0	18 0 0	Do.
Conway	3	2	11 2 0	15 8 0	26 10 0	Dr. Wheaton.
Corwen	4	2	3 14 0	5 15 0	9 9 0	Do.
Cosford	5	4	3 4 0	10 12 0	28 9 0	„ Copeman.
Cranbrook	6	6	1 9 0	4 10 0	14 13 0	„ Sweeting.
Crickhowell	2	1	—	—	7 6 0	„ Bulstrode.
Croydon	6	6	1 7 0	16 5 0	38 4 0	„ Thomson.
Dartford	6	5	7 8 0	21 3 0	66 5 0	Dr. Sweeting.
Derby	2	2	1 5 0	3 4 0	4 9 0	„ Buchanan.
Dewsbury	13	10	0 8 0	5 17 0	35 14 0	„ Johnstone.
Dolgelly	5	1	—	—	4 1 0	„ Wheaton.
Doncaster	8	5	1 1 0	12 9 0	18 18 0	„ Johnstone.
Dorchester	6	5	0 15 0	11 1 0	22 9 0	Mr. Royle.
Dorking	5	2	0 8 0	1 9 0	1 17 0	Dr. Thomson.
Dover	5	2	1 6 0	11 16 0	13 2 0	„ Sweeting.
Drayton	5	4	0 18 0	7 9 0	14 7 0	„ Reece.
Driffield	8	5	0 7 0	6 2 0	14 18 0	„ Johnstone.
Dulverton	2	2	0 9 0	9 12 0	10 1 0	Mr. Royle.
Dursley	3	2	2 6 0	4 12 0	6 18 0	Dr. Mivart.
Eastbourne	5	5	1 5 0	4 17 0	14 8 0	Dr. Reece.
East Grinstead ..	5	5	1 6 0	7 11 0	15 5 0	Do.
East Preston	3	1	—	—	13 16 0	Do.

APP. A, No. 2.

Inspection of Vaccination, and Awards to Public Vaccinators, 1899.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union.		Total Sum awarded in each Union.	Medical Inspector.
			Minimum.	Maximum.		
			£ s. d.	£ s. d.	£ s. d.	
East Retford	6	6	2 16 0	19 14 0	45 8 0	Dr. Darra Mair.
Eastry	7	6	3 14 0	10 12 0	33 17 0	" Sweeting.
Ecclesall Bierlow ..	3	3	1 5 0	25 0 0	36 5 0	" Johnstone.
Elham	5	5	1 11 0	22 5 0	38 16 0	" Sweeting.
Epping	9	6	1 8 0	10 5 0	35 11 0	" Mivart.
Epsom	9	8	0 4 0	4 14 0	19 9 0	" Thomson.
Eton	9	6	0 7 0	9 14 0	29 8 0	" Fletcher.
Exeter	1	1	—	—	37 5 0	" Bruce Low.
Falmouth	4	1	—	—	1 0 0	Mr. Royle.
Farnham	7	6	1 1 0	7 9 0	21 10 0	Dr. Thomson.
Faversham	4	4	1 9 0	17 6 0	30 3 0	" Sweeting.
Festiniog	5	3	5 2 0	14 2 0	26 11 0	" Wheaton.
Fordingbridge ..	2	2	4 7 0	5 6 0	9 13 0	" Bulstrode.
Frome	5	5	1 15 0	8 7 0	22 6 0	Mr. Royle.
George, St., East ..	1	1	—	—	85 3 0	Dr. Sweeting.
German's, St.	6	6	1 8 0	7 16 0	25 5 0	Mr. Royle.
Glossop	1	—	—	—	—	Dr. Buchanan.
Godstone	5	5	1 8 0	2 3 0	9 1 0	" Thomson.
Goole	4	3	1 5 0	8 19 0	12 9 0	" Johnstone.
Gower	3	3	2 17 0	10 13 0	22 4 0	Do.
Gravesend and Milton	1	1	—	—	6 0 0	" Sweeting.
Grimsby	4	2	26 1 0	27 16 0	53 17 0	" Darra Mair.
Guildford	9	8	1 6 0	6 10 0	24 9 0	" Thomson.
Hackney	4	2	21 18 0	28 17 0	50 15 0	Dr. Sweeting.
Hailsham	7	6	0 11 0	9 11 0	30 11 0	" Reece.
Hambledon	5	5	2 2 0	5 7 0	16 19 0	" Thomson.
Hartismere	5	4	0 12 0	4 16 0	13 0 0	" Copeman.
Hartley Wintney ..	7	5	0 11 0	3 13 0	10 19 0	" Bulstrode.
Haslingden	4	4	6 11 0	24 2 0	60 15 0	" Wheaton.
Haverfordwest ..	4	4	9 18 0	13 14 0	49 13 0	" Darra Mair.
Hay	3	2	2 9 0	4 16 0	7 5 0	" Bulstrode.
Hayfield	1	1	—	—	15 18 0	" Buchanan.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union.		Total Sum awarded in each Union.	Medical Inspector.
			Minimum.	Maximum.		
			£ s. d.	£ s. d.	£ s. d.	
Helston	5	5	3 1 0	6 6 0	23 10 0	Mr. Royle.
Hemsworth	4	4	1 0 0	8 11 0	18 18 0	Dr. Johnstone.
Hollingbourne ..	6	4	1 11 0	5 2 0	12 7 0	„ Sweeting.
Hoo	1	1	—	—	3 15 0	Do.
Howden..	4	3	3 2 0	6 15 0	15 4 0	„ Johnstone.
Hoxne	8	4	0 8 0	5 1 0	8 14 0	„ Copeman.
Huddersfield	16	10	1 4 0	10 2 0	50 17 0	„ Johnstone.
Ipswich	1	1	—	—	17 6 0	Dr. Copeman.
Islington	11	3	33 0 0	56 16 0	138 10 0	„ Sweeting.
Keynsham	6	3	1 12 0	13 1 0	23 0 0	Mr. Royle.
Kingston - on - Hull (L.A.).	2	1	—	—	24 5 0	Dr. Johnstone.
Kingston-on-Thames	11	10	0 12 0	13 18 0	38 8 0	„ Thomson.
Lambeth	5	5	16 4 0	104 9 0	283 11 0	Dr. Sweeting.
Lancaster	5	4	1 18 0	24 8 0	36 15 0	„ Fletcher.
Langport	6	5	1 3 0	7 3 0	24 7 0	Mr. Royle.
Launceston	8	8	1 2 0	4 4 0	23 12 0	Do.
Leeds	7	7	1 14 0	61 16 0	194 8 0	Dr. Bruce Low.
Leek	6	6	1 4 0	14 13 0	41 18 0	„ Wheaton.
Leighton Buzzard ..	2	1	—	—	0 12 0	„ Fletcher.
Lewes	6	5	0 14 0	7 4 0	15 2 0	„ Reece.
Lewisham	6	5	5 8 0	10 16 0	42 12 0	„ Sweeting.
Leyburn	6	3	0 14 0	6 8 0	9 4 0	„ Buchanan.
Lichfield	6	3	2 17 0	18 3 0	36 15 0	„ Wheaton.
Liskeard	8	5	1 16 0	8 17 0	23 9 0	Mr. Royle.
Llandilo Fawr ..	5	4	2 16 0	12 10 0	26 13 0	Dr. Bulstrode.
Llandovery	2	2	6 19 0	11 18 0	18 17 0	Do.
Llanelly..	3	3	20 4 0	74 9 0	120 2 0	Do.
Loddon and Clavering	4	4	3 17 0	5 7 0	18 12 0	„ Copeman.
London City	2	2	2 2 0	8 1 0	10 3 0	„ Sweeting.
Long Ashton	9	4	4 2 0	6 0 0	20 18 0	Mr. Royle.
Lunesdale	4	4	0 2 0	4 18 0	8 6 0	Dr. Fletcher.

App. A, No. 2.

Inspection of Vaccination, and Awards to Public Vaccinators, 1899.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union.		Total Sum awarded in each Union.	Medical Inspector.
			Minimum.	Maximum.		
			£ s. d.	£ s. d.	£ s. d.	
Luton	5	1	—	—	0 1 0	Dr. Fletcher.
Lymington	4	2	2 6 0	4 18 0	7 4 0	„ Bulstrode.
Madeley	4	2	4 12 0	17 9 0	22 1 0	Dr. Reece.
Maidstone	5	5	2 11 0	9 1 0	28 7 0	„ Sweeting.
Malling	7	6	2 19 0	8 4 0	32 4 0	Do.
Mansfield	7	6	4 3 0	16 14 0	54 8 0	„ Darra Mair.
Marlborough	2	1	—	—	3 4 0	„ Johnstone.
Marylebone	2	2	57 11 0	84 15 0	142 6 0	„ Sweeting.
Medway	3	2	11 2 0	33 9 0	44 11 0	Do.
Merthyr Tydfil ..	10	9	10 10 0	97 1 0	379 11 0	„ Johnstone.
Mildenhall	3	1	—	—	4 10 0	„ Copeman.
Mile End Old Town	2	2	13 14 0	47 16 0	61 10 0	„ Sweeting.
Milton	2	2	5 10 0	12 9 0	17 19 0	Do.
Mutford and Lothingland.	3	3	3 9 0	36 8 0	57 9 0	„ Copeman.
Narberth	4	4	7 2 0	9 10 0	34 12 0	Dr. Darra Mair.
Neath	6	4	12 16 0	57 14 0	104 15 0	„ Johnstone.
Newark	8	6	1 2 0	4 14 0	14 7 0	„ Darra Mair.
Newcastle-in-Emlyn	3	3	7 17 0	14 1 0	35 4 0	„ Bulstrode.
Newcastle - under - Lyme.	3	1	—	—	46 1 0	„ Wheaton.
Newcastle-on-Tyne..	4	4	36 8 0	94 18 0	220 16 0	„ Bruce Low.
New Forest	5	5	0 14 0	8 5 0	18 14 0	„ Bulstrode.
Newhaven	5	5	0 14 0	15 5 0	23 18 0	„ Reece.
Newport (Salop) ..	4	2	4 17 0	4 18 0	9 15 0	Do.
Northallerton	4	4	0 17 0	12 17 0	19 6 0	„ Buchanan.
Northleach	5	4	0 19 0	4 16 0	12 14 0	„ Mivart.
Nottingham	6	3	3 19 0	35 19 0	44 0 0	„ Darra Mair.
Oakham	3	2	6 11 0	13 13 0	20 4 0	Dr. Darra Mair.
*Oldham	6	6	4 7 0	17 4 0	59 17 0	„ Wheaton
Ongar	4	4	3 10 0	4 18 0	16 14 0	„ Mivart.
Ormskirk	7	9	1 4 0	32 12 0	78 16 0	„ Fletcher.
Orsett	5	2	2 19 0	8 7 0	11 6 0	„ Mivart.

* This union does not appear in the corresponding table in the Local Government Board's report, 1899-1900, as the awards in respect of it had not been certified by the Board when the report was sent to press.

UNION.	No. of Vaccination Districts in the Union.	No. of Public Vaccinators recommended for Award.	Range of Awards in each Union. Minimum.	Range of Awards in each Union. Maximum.	Total Sum awarded in each Union.	Medical Inspector.
			£ s. d.	£ s. d.	£ s. d.	
Pancras, St.	1	1	—	—	118 2 0	Dr. Sweeting.
Patrington	5	3	2 3 0	2 18 0	7 16 0	„ Johnstone.
Pembroke	6	4	2 10 0	14 0 0	32 5 0	„ Darra Mair.
Penistone	3	3	1 8 0	6 12 0	11 14 0	„ Johnstone.
Penzance	5	4	4 1 0	17 18 0	49 7 0	Mr. Royle.
Plomesgate	6	5	2 10 0	6 11 0	21 8 0	Dr. Copeman.
Pocklington	7	3	2 7 0	5 11 0	11 4 0	„ Johnstone.
Pontardawe	2	2	38 3 0	51 8 0	89 11 0	Do.
Pontefract	7	6	4 12 0	23 14 0	67 11 0	Do.
Pontypridd	11	8	12 19 0	95 1 0	404 3 0	Do.
Poole	4	3	2 3 0	9 10 0	14 4 0	Mr. Royle.
Pwllheli..	6	1	—	—	6 1 0	Dr. Wheaton.
Redruth	6	2	8 8 0	12 0 0	20 8 0	Mr Royle.
Reeth	2	1	—	—	4 10 0	Dr. Buchanan.
Reigate	4	1	—	—	5 4 0	„ Thomson.
Richmond (Surrey)..	3	3	3 13 0	10 0 0	17 7 0	Do.
Richmond (Yorks) ..	5	2	5 13 0	9 0 0	14 13 0	„ Buchanan.
Ringwood	1	1	—	—	9 6 0	„ Bulstrode.
Risbridge	5	5	2 16 0	12 9 0	30 9 0	„ Copeman.
Romford	6	6	1 0 0	21 5 0	69 18 0	„ Mivart.
Romney Marsh ..	3	2	0 15 0	3 5 0	4 0 0	„ Sweeting.
Rotherham	9	4	2 4 0	15 18 0	37 14 0	„ Johnstone.
Saddleworth	1	1	—	—	5 12 0	Dr. Johnstone.
Samford..	4	4	1 16 0	6 10 0	15 13 0	„ Copeman.
Sculcoates	6	5	1 13 0	87 6 0	192 3 0	„ Johnstone.
Seisdon	4	3	1 11 0	3 10 0	7 12 0	„ Wheaton.
Selby	4	2	1 11 0	10 8 0	11 19 0	„ Johnstone.
Sevenoaks	6	6	1 7 0	5 16 0	20 4 0	„ Sweeting
Shaftesbury	4	3	3 3 0	8 10 0	15 5 0	Mr. Royle.
Shardlow	9	7	0 18 0	13 14 0	34 16 0	Dr. Buchanan.
Sheffield..	8	5	22 14 0	59 16 0	187 17 0	„ Bruce Low
Sheppey	2	2	5 7 0	15 10 0	20 17 0	„ Sweeting.

APP. A, No. 3.

National Vaccine Establishment, 1899.

No. 3.

STATISTICS OF THE NATIONAL VACCINE ESTABLISHMENT.

I.—EDUCATIONAL VACCINATION STATIONS, 1899.

Provisional Arrangements.

In order to provide for the granting of those special certificates of proficiency in vaccination which are required to be part of the medical qualification for entering into contracts for the performance of public vaccination, or for acting as deputy to a contractor, the following arrangements are made :—

(1.) The vaccination stations enumerated in the subjoined list are open, under certain specified conditions, for the purpose of teaching and examination ;

(2.) The vaccinators officiating at these stations are authorised to give the required certificate of proficiency in vaccination to persons whom they have sufficiently instructed therein ; and

(3.) The vaccinators whose names in the subjoined list are printed in *italic letters* are also authorised to give such certificates, after satisfactory examination, to persons whom they have not themselves instructed.

Cities and Towns having Educational Vaccination Stations.	Places used as Educational Vaccination Stations.	Vaccinators authorised to give Certificates of Proficiency in Vaccination.	Days and Hours of Attendance of the Vaccinators at Stations where periodic Courses of Instruction are given (*a*).
London ...	(Principal Station) Surrey Chapel, Blackfriars Road.	*Dr. Robert Cory** ... 73, Lambeth Palace Road, S.E.	Tues., Thurs., 2.
	St. Thomas's Hospital	Dr. Robert Cory ... *See* above.	Wed., 11.30.
	Tottenham Court Chapel, Tottenham Court Road.	*Mr. Joseph Loane* ... 98, Tressillian Road, St. John's, S.E.	Mon., Wed., 1.
	St. Mary's Hospital Middlesex Hospital St. George's Hospital	Mr. Edward Climson Greenwood, 19, St. John's Wood Park, N.W.	Tuesday, 11. Friday, 3. Wed., 3.
	26, Bessborough Gardens, S.W.	Dr. Albert Ernest Cope, 26, Bessborough Gardens, S.W.	Mon., Thurs., 3.30.
	42, Bloomsbury Square, W.C.	Mr. John Francis Staines, 42, Bloomsbury Square, W.C.	Tues., 10.15.
	St. Olave's and St. John's Institute, Tooley Street, S.E.	Mr. Victor Alexander Jaynes, 157, Jamaica Road, Bermondsey, S.E	Wed., 3.
	Eastern Dispensary, Leman Street.	Mr. Joseph Loane ... *See* above.	Wed., 11.
	144, Euston Road, N.W.	Miss Mary Thorne, M.D., 10, Nottingham Place, W.	Friday, 9.

(*a*) Candidates for Certificates should communicate with the authorised teacher or examiner to learn the dates of his or her regular courses.

* Dr. Cory died, March 1900 ; arrangements were then made for discontinuance of the Surrey Chapel as a Vaccination station.

I.—EDUCATIONAL VACCINATION STATIONS, 1899—*continued.*

Cities and Towns having Educational Vaccination Stations.	Places used as Educational Vaccination Stations.	Vaccinators authorised to give Certificates of Proficiency in Vaccination.	Days and Hours of Attendance of the Vaccinators at Stations where periodic Courses of Instruction are given (*a*).
Birmingham	Priory Rooms, Upper Priory.	*Dr. Edmund Robinson*... 213, Bristol Road, Edgbaston, Birmingham.	Monday, 1.30.
Bristol ...	St. Peter's Hospital, Bristol.	*Mr. George Shepley Page*, 78, Old Market Street, Bristol.	Wed., 11.
Cambridge..	The Coffee Palace, 160, East Road.	*Dr. Robert Cory** ... 73, Lambeth Palace Road, S.E.	Friday, 11.
Cardiff ...	Roath Church Institute, Sun Street, Roath.	*Mr. John Llewellyn Treharne*, 92, Newport Road, Cardiff.	Tuesday, 11.
Exeter ...	20, Southernhay ...	*Mr. William A. Budd*, 20, West Southernhay, Exeter.	*See* footnote (*a*)
Leeds ...	1, Sarah Street, Burmantofts Street.	*Mr. Frederic Holmes* ... Springfield House, Burmantofts, Leeds.	Tuesday, 2.30.
Liverpool ...	177, Mulgrave Street	*Mr. Nathaniel Edward Roberts*, 33, Mulgrave Street, Liverpool.	Tuesday, 3.
Newcastle-on-Tyne.	The Dispensary, Nelson Street.	*Dr. Frank Hawthorn* ... 6, Regent Terrace, Newcastle-on-Tyne.	Wednesday, 3.
Salford ...	Brotherton Hall, 252, Chapel Street, Salford.	*Dr. Alexander Carson Clarke*, Roman Place, Higher Broughton, Manchester.	Thursday, 2.
Sheffield ...	250, Brook Hill, Sheffield.	*Mr. William Skinner* ... 250, Brook Hill, Sheffield.	Tuesday, 3.
Aberdeen ...	The Public Dispensary.	*Mr. Robert Gordon McKerron*, 1, Albyn Place, Aberdeen.	Wed., 2.30.
Dundee ...	Royal Infirmary ...	Dr. Robert Cockrane Buist, 166, Nethergate, Dundee.	Thursday, 2.
Edinburgh	The Royal Dispensary	*Dr. William Husband*... 4, Royal Circus, Edinburgh.	Wed., Sat., 12.
	The Western Dispensary, Ponton Street	*Dr. John Brown Buist*, 1, Clifton Terrace, Edinburgh.	Thursday, 3.
	The New Town Dispensary.	Dr. Francis Cadell ... 22, Ainslie Place, Edinburgh.	Tuesday, 12.

(*a*) Candidates for Certificates should communicate with the authorised teacher or examiner to learn the dates of his or her regular courses.

* Died, March 1900.

I.—EDUCATIONAL VACCINATION STATIONS, 1899—*continued.*

Cities and Towns having Educational Vaccination Stations.	Places used as Educational Vaccination Stations.	Vaccinators authorised to give Certificates of Proficiency in Vaccination.	Days and Hours of Attendance of the Vaccinators at Stations where periodic Courses of Instruction are given (*a*).
Glasgow ...	The Royal Infirmary	*Mr. Robert Home Henderson*, 19, Elmbank Place, Glasgow.	Monday 12 (Women). Thursday, 12 (Men).
	The Western Infirmary.	Mr. John Wyllie Nicol, 7, Kersland Terrace, Glasgow.	Monday, 12.
Dublin ...	45, Upper Sackville Street.	*Dr. Alexander Nixon Montgomery*, 45, Upper Sackville Street, Dublin.	Tues., Fri., 10.

(*a*) Candidates for Certificates should communicate with the authorised teacher or examiner to learn the dates of his or her regular courses.

II.—ANIMAL VACCINE STATION.

The Animal Vaccine Station is at 95, Lamb's Conduit Street, where Mr. T. S. Stott and Dr. Leslie Thorne Thorne attend for the Vaccination of Children on Tuesdays and Thursdays at 10.30 a.m.

III.—DISTRIBUTION OF GLYCERINATED CALF LYMPH, 1899.

Number of applications from Public Vaccinators ...	47,097
Supplies sent out :—	
Charged capillary tubes	499,281

No. 4.

REPORT on the OPERATIONS of the ANIMAL VACCINE ESTABLISHMENT at LAMB'S CONDUIT STREET, during the year 1899–1900; by Mr. THOMAS S. STOTT, Director.

APP. A. No. 4.

On the Operations of the Animal Vaccine Establishment, 1899-1900; by Mr. Stott.

Owing to the lamented death of the Director, my friend and colleague, Dr. Cory, it becomes my duty to present this report.

During the year April 1st, 1899, to March 31st, 1900, 156 calves were vaccinated. The aggregate weight on reception at Lamb's Conduit Street of the 156 calves* was 46,760 lbs. On dismissal from the station their aggregate weights were 49,032 lbs., so that during retention for vaccination purposes they gained considerably in weight, namely, by an average of 14·6 lbs.

Of the above calves 145 were vaccinated direct from other calves, and 11 were vaccinated with calf lymph which had been stored. As usual, vaccinations performed with direct lymph proved more successful than the others. Insertions to the number of 5,540 in calf-to-calf operations produced 5,416 vesicles; in the 11 cases vaccinated with lymph stored in tubes, 452 insertions produced only 360 vesicles, giving rates of insertion success respectively of 97·8 and 79·6 per cent.

No material difference in the results of calf-to-calf vaccinations was observed whether the lymph used was from calves vaccinated 96 hours, or from calves vaccinated 120 hours previously; in either case the rate of insertion success was practically 97·7 per cent.

Primary Vaccinations.—During the year 1899–1900, exclusive of one case vaccinated for the cure of nævus, there were performed 2,615 primary vaccinations, five separate insertions of lymph being made in each instance. Of the persons thus vaccinated 1,399 were males and 1,216 were females. All but 149 of the primary vaccinations succeeded at the first attempt.

There were 980 primary vaccinations performed from calf-to-arm. Of 966 persons primarily vaccinated by the several staff operators with calf-to-arm lymph 8 failed to return for inspection. Of the 958 remaining 825 on examination were found to have taken in five places, 45 in four, 28 in three, 19 in two, 15 in one place, and 26 failed on the first attempt. The aggregate insertion success rate was, therefore, 92·7 per cent. Students vaccinated 14 cases, of which 11 took in five places, 1 in four, and 2 failed at the first attempt, their insertion success rate. therefore, being 84·3 per cent.

Glycerinated Calf Lymph.—During the same period, 1,634 primary vaccinations were performed with glycerinated calf lymph by Dr. Cory and myself. Of these 17 failed to return for inspection, and of the 1,617 remaining 1,029 on examination were found to have taken in five places, 179 in four, 103 in three, 81 in two, 104 in one, and 121 failed at the first attempt. Our insertion success rate, therefore, was 79·6 per cent.

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* Only one female calf was vaccinated.

APP. A, No. 4.

On the Operations of the Animal Vaccine Establishment, 1899-1900; by Mr. Stott.

Revaccinations.—These numbered 988, and all were performed from calf-to-arm. The several staff operators performed 951, of which cases 10 failed to return for inspection. Of the remaining 941 cases, 810 on inspection were successful in five places, 59 in four, 28 in three, 15 in two, 11 in one, and 18 failed, giving an insertion success rate of 93·8 per cent.

Students vaccinated 37 cases; 2 failed to return for inspection; of the remaining 35 cases 27 were successful in five places, 3 in four, 2 in three, and 3 failed at first attempt. Students' insertion success rate, therefore, was 87·4 per cent.

There were 25 cases brought back after inspection on account of some abnormal course of their vaccination. In the great majority of cases, namely, in 21, the abnormality consisted of sore arm, in many instances caused by domestic maltreatment; there were 2 cases of transient eruption, and 2 cases were reported to be erysipelas commencing respectively on the fifteenth day and the eleventh day after vaccination.

No. 5.

REPORT on the OPERATIONS of the GLYCERINATED CALF LYMPH ESTABLISHMENT, 1899-1900; by DR. FRANK R. BLAXALL.

APP. A, No. 5.

On the Operations of the Glycerinated Calf Lymph Establishment, 1899-1900; by Dr. Blaxall.

During the year April 1st, 1899, to March 31st, 1900, the work of the Glycerinated Calf Lymph Establishment has greatly increased.

The large demand for lymph, of which mention was made in my last report, continued, and in the summer months further increased, a very large number of tubes being despatched as is shown in the appended table (Table I.).

During these summer months the hot dry weather experienced acted prejudicially upon the lymph, and this in two ways. Firstly, the glycerinated lymph despatched to public vaccinators was liable on its receipt to be exposed to high temperatures, owing to the fact that the recipients were unable to use it all at once, or from inability to store it in a cool place. Secondly, the hot weather acted detrimentally on the production of vesicles on the calves themselves. In such conditions the vesicles tend to run a very rapid course, and become dry, crusty, and aborted, and thus the yields of lymph are small in quantity and of variable quality. This is the common experience at continental vaccinating stations during the hot season, as also at Indian stations and others liable to great heat.

To combat the adverse meteorological conditions every effort was made to keep the calves in an atmosphere as cool as possible by the free use of water and ice.

At this time the demand for glycerinated lymphs was abnormally high, as many as 50,000 tubes being sent out in June, and this notwithstanding limitation of the supply afforded to many of the applicants. To obtain sufficient quantity of lymph to meet such demands, it became necessary to largely increase the number of calves vaccinated, and since the stables admitted practically of no extension this could be done only with great difficulty and with some danger of overcrowding.

The autumn, although cooler, did not appreciably relieve the situation, for all the calves obtainable had suffered so much from bad and insufficient feeding during the prolonged drought that they were in the poorest of health and responded only feebly to vaccination, many of them, indeed, entirely failing to yield vesicles.

In November the demand for lymph suddenly increased, owing to the outbreak of small-pox at Hull and the surrounding district.

This, and the continued ill-condition of the calves, together with the fact that the existing staff of the establishment were

APP. A, No. 5.

On the Operations of the Glycerinated Calf Lymph Establishment, 1899-1900: by Dr Blaxall.

unable to cope with more work, rendered necessary extension of the stabling accommodation and of the staff. Additional stabling room was found close at hand in Harpur Mews, wherein 12 calves were stalled, and the staff was increased by—

1 Medical Assistant, to aid in vaccinating the calves;

1 Laboratory Assistant;

1 Stableman.

By these means we were enabled to meet the current demands for lymph.

Especial attention has been paid to the stabling and diet of the calves, and many alterations of detail have been instituted which, apparently, have resulted in a considerable improvement in the condition of the calves, so that they respond more freely to vaccination and yield lymph of better quality.

The methods pursued in vaccinating, collecting, and glycerinating the lymph are the same as those set forth in my last report.

The work on the Bacteriological Flora of Vaccine Lymph before and *pari passu* with its admixture with glycerine has been worked out in detail by Mr. Fremlin, whose report I append.

Other research work in connection with vaccine lymph, especially that dealing with the standardising of lymph, and the effect of Röntgen rays upon lymph and the contained organisms, has been carried on from time to time, but has not yet arrived at a stage sufficiently definite for publication, owing to the great pressure of work experienced by the department.

During the year lymph from 269 calves has been sent out from the department. All these calves were after slaughter examined by our veterinary surgeon and certified to be healthy. Two other calves, which appeared to be in health during the course of vaccination, were found at the autopsy by the veterinary surgeon to exhibit tubercular lesions in certain glands and other organs. The lymph obtained from these calves was at once destroyed; none of it was issued. The recording of the results of the use of the lymph was carried on on the same lines as indicated in my last report.

Included in the statistics appended are figures relating to the first quarter of 1899 as being useful for purposes of comparison.

Table I. gives the numerical details as to the despatch of lymph to the National Vaccine Establishment, and Tables II., III., and IV. give the results of the use of the lymph as shown by statistics dealing with 537,917 cases of primary vaccination and revaccination.

App. A, No. 5.
On the Operations of the Glycerinated Calf Lymph Establishment, 1899-1900; by Dr. Blaxall.

TABLE I.

Showing number of TUBES of GLYCERINATED CALF LYMPH sent from LABORATORIES to NATIONAL VACCINE ESTABLISHMENT from commencement of despatch to 31st March, 1900.

Dates.	Tubes sent during 1899. Weekly.	Monthly.	Quarterly.	Dates.	Tubes sent during First Quarter of 1900. Weekly.	Monthly	Quarterly.
Jan. 7	10,711	January, 43,914	First Quarter, 125,038	Jan. 6	5,150	January, 31,870	First Quarter, 110,614
14	12,538			13	6,568		
21	7,569			20	7,525		
28	9,190			27	7,885		
Feb. 4	9,733	February, 39,680		Feb. 3	7,936	February, 31,818	
11	9,500			10	8,015		
18	10,253			17	6,222		
25	10,700			24	8,739		
Mar. 4	9,844	March, 41,444		Mar. 3	9,526	March 46,926	
11	10,200			10	11,869		
18	9,800			17	11,852		
25	9,900			24	10,461		
				31	8,866		
April 1	6,100	April, 39,800	Second Quarter, 138,600				
8	6,900						
15	9,600						
22	10,600						
29	11,700						
May 6	11,300	May, 48,800					
13	10,900						
20	10,900						
27	8,900						
June 3	10,400	June, 50,000					
10	13,800						
17	12,300						
24	11,600						
July 1	10,000	July, 41,920	Third Quarter, 121,598				
8	9,900						
15	9,400						
22	9,020						
29	10,100						
Aug. 5	8,500	August, 37,704					
12	8,604						
19	8,700						
26	8,150						
Sept. 2	8,300	September, 41,974					
9	9,112						
16	10,202						
23	10,364						
30	9,946						
Oct. 7	9,204	October, 41,632	Fourth Quarter, 114,452				
14	9,540						
21	9,758						
28	9,311						
Nov. 4	8,823	November, 46,859					
11	9,387						
18	10,232						
25	14,960						
Dec. 2	9,822	December, 26,061					
9	9,871						
16	6,573						
23	4,135						
30	2,816						
Totals	499,688	499,688	499,688				

App. A, No. 5.

On the Operations of the Glycerinated Calf Lymph Establishment, 1899–1900; by Dr. Blaxall.

TABLES showing results of the use of GLYCERINATED CALF LYMPH sent out during periods mentioned.

TABLE II.—TOTAL CASES.

Period during which sent out.	Number of cases used for.	Percentage success.	
		Case.	Insertion.
March Quarter 1899	99,170	96·3	89·0
June " "	121,704	92·3	81·5
September " "	107,869	86·1	71·6
December " "	104,822	93·5	82·4
March " 1900	104,352	97·3	90·9
Total	537,917	93·0	83·0

TABLE III.—PRIMARY CASES.

Period during which sent out.	Number of cases used for.	Percentage success.	
		Case.	Insertion.
March Quarter 1899	98,571	96·3	89·1
June " "	118,796	92·3	81·6
September " "	105,836	86·1	71·7
December " "	91,003	93·9	83·7
March " 1900	102,376	97·3	90·9
Total	516,582	93·1	83·1

TABLE IV.—REVACCINATIONS.

Period during which sent out.	Number of cases used for.	Percentage success.	
		Case.	Insertion.
March Quarter 1899	599	91·7	81·7
June " "	2,908	91·2	78·2
September " "	2,033	88·2	78·3
December " "	13,819	91·1	77·3
March " 1900	1,976	94·5	90·4
Total	21,335	91·2	78·8

No. 6.

ABSTRACT of MEDICAL INSPECTIONS made in 1899 with regard to the INCIDENCE of DISEASE on particular places, and to questions concerning LOCAL SANITARY ADMINISTRATION.

APP. A, No. 6.
Abstract of Medical Inspections.

1. **ALDERSHOT (HAMPSHIRE)**; population (estimated), Town 16,500, and Camp 13,894; Dr. Reece.

Authorities concerned: Aldershot Urban District Council, and incidentally the War Office as regards the Camp.

Ground of Inquiry: Continued fatal prevalence of diphtheria—Registrar-General's Returns.

Chief Facts reported by Inspector: Statistics as to fatal diphtheria in district since 1876; and as to notified diphtheria since 1891. Close relationship between Town and Camp. In 1895–96 diphtheria epidemic among soldiers in Camp, also affecting their children. In 1896 and 1897 attack-rate on children in Camp high: 28·47 and 23·65 per 1,000 under 15 years of age. Since 1897 increasing diphtheria in Town; town attack-rate for children 0–15, being 19·00 per 1,000 in 1897, and 22·64 per 1,000 in 1898.

No isolation hospital provision or proper disinfecting apparatus established by Urban District Council until 1899. Public water supply by private company, from the Chalk by deep borings. Local wells liable to pollution. Sewerage imperfect; many old sewers; ventilation now being provided for sewers; flushing inefficient. System of storm-water drains hitherto found inadequate. House drainage often faulty. Some 25 to 30 per cent. of water-closets hand flushed; but few privies. Sewage treated by chemical precipitation and broad irrigation, and part by bacterial filters; storm tank for reception of sewage during heavy rainfall. Hitherto treatment of sewage not altogether satisfactory. Houses often damp. Back yards need paving. Common lodging-house byelaws often flagrantly violated. Houses let in lodgings should be regulated by byelaws. Footpaths need attention. Animals kept so as to become nuisances. Dairies, cowsheds, and milkshop regulations not strictly enforced.

2. **AXMINSTER RURAL DISTRICT (DEVON)**; population (1891), 12,580; Dr. Mivart.

Authority concerned: Axminster Rural District Council.

Ground of Inquiry: General sanitary circumstances and administration—Local complaints and reports of Medical Officer of Health.

Chief Facts reported by Inspector: Dwelling accommodation insufficient and in many ways unsatisfactory. Water supply insufficient, in many places grave distress caused thereby. Sewers unsuitable and obsolete. Excrement and refuse disposal unsatisfactory. Filth nuisances everywhere abundant. No registration or regulation of slaughter-houses, dairies, or bakehouses. No isolation hospital. No disinfection practised. Although abundant urban powers acquired, no byelaws, except in regard to pleasure boats in one parish. General sanitary administration extremely lax.

3. BIGGLESWADE RURAL DISTRICT (BEDS); population (1891), 21,864; Dr. Mivart.

Authority concerned: Biggleswade Rural District Council.

Ground of Inquiry; Diphtheria and enteric fever—local complaints.

Chief Facts reported by Inspector: Diphtheria extensively prevalent in Sandy parish for many years past; in 1898 202 cases; great incidence on children of working class; probable spread by personal contact, especially in school; type of epidemic mild. Diphtheria also in Langford parish. During 1898, 42 cases, with eight deaths. Personal contact mainly responsible, especially at schools, which were not closed. Type of disease moderately severe. Limited outbreak of enteric fever at Old Warden in autumn of 1898; 14 cases with four deaths; cause obscure, but first cases associated with consumption of contaminated water.

Water supply throughout district generally from shallow wells, liable to be polluted. Sewerage and drainage defective; filth nuisances abundant. Public scavenging adopted for only one parish; in one other, cesspools emptied by hand pumps and carts. No registration or regulation of dairies, cowsheds, &c. Byelaws as to slaughter-houses a dead letter. Practically no disinfection practised. Hospital accommodation insufficient.

4. BILSTON (STAFFORDSHIRE); population (1891), 23,500; Dr. Darra Mair.

Authority concerned: Bilston Urban District Council.

Ground of Inquiry: Enteric fever—Registrar-General's Returns.

Chief Facts reported by Inspector: Many back to back houses. Much fouling of surface near houses from absence or imperfection of rain gutters and spouting, and from defective yard paving. Yards badly drained usually by surface channels. Majority of houses provided with midden privies or vault privies, some with pail privies, and a few with water-closets. Removal of excrement and refuse from houses unsatisfactory: work done by a contractor. Incomplete system of sewers: very defective outfall sewer and sewage disposal works. Water supply, owned by District Council, from wells in new red sandstone, near Bilston. Local Act in force containing several useful, but not enforced, provisions. Building byelaws too lax and not properly enforced. Sanitary staff inadequate. Time of Inspector of Nuisances largely taken up with supervision of scavenging. Isolation hospital inadequate, and not used for fever cases till late in the prevalence.

Much increase of enteric fever in latter half of 1898 mainly in eastern portion of Bilston town, and in Bradley, part of which is in Coseley district. Fever in Bradley due in the main to well-water drunk at an ironworks, which became infective during some sewer repairs in the vicinity of the well. Fever in Bilston not traceable to water, or milk supplies, or to sewerage; it apparently selected those parts of the town where filth conditions were most aggravated.

5. **BOLTON (LANCASHIRE) :—GATHERING GROUNDS AND WATERWORKS OF BOLTON CORPORATION**; Dr. G. S. Buchanan and Mr. R. H. Bicknell.

Authority concerned: Bolton Town Council.

Ground of Inquiry: Application by Town Council for loan in connection with their water undertaking; circumstances causing the Board to require knowledge in detail of the precautions taken to guard the Bolton supply from contamination, and to neutralise its ability to dissolve lead.

Chief Facts reported by Inspectors: Total population supplied from these waterworks estimated at 272,000, comprising Bolton County Borough, seven urban districts, and parts of one urban and of two rural districts. Supply from three gathering grounds, Entwistle, Heaton, and Dingle. Data of rainfall, volume, &c., and particulars of distribution of water from these several sources. Report of conditions observed on each gathering ground. Description of filtration adopted, and of liability of certain service reservoirs to contamination.

Conclusion that the Corporation, although managing their water undertaking in several respects creditably, have in other ways neglected to take adequate precautions for safeguarding the purity of their supply. Systematic inspection of gathering areas, and obtaining advice of Medical Officer of Health, particularly needful. Adequate precautions to remove lead dissolving properties of water derived from Dingle gathering ground essential.

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Abstract of Medical Inspections.

6. BRAINTREE RURAL DISTRICT (ESSEX); population (1891), 19,734; Dr. Fletcher.

Authority concerned: Braintree Rural District Council.

Ground of Inquiry: Joint tenure, by one person, of the offices of Surveyor of Highways and Inspector of Nuisances for the whole district.

Chief Facts reported by Inspector: Area of the district, 62,291 acres. Length of district roads, 193 miles. District Council have appointed one person to perform, with the aid of one assistant, the duties of Inspector of Nuisances and Surveyor of Highways: also he is expected to act as District Surveyor without salary. Account of various insanitary circumstances in different parts of the district, and of numerous preventable nuisances. Conclusion that work of Inspector of Nuisances neglected, and much delegated to an incompetent assistant. Ample work to fully occupy one man as Inspector of Nuisances.

7. CHAILEY RURAL DISTRICT (SUSSEX); population (1891), 11,899; Dr. Mivart.

Authority concerned: Chailey Rural District Council.

Ground of Inquiry: Knowledge of general sanitary circumstances and administration required by the Board.

Chief Facts reported by Inspector: Water supply from wells liable to contamination. Great scarcity of water in dry weather, and consequent hardship. Sewerage insufficient, and mostly of obsolete patterns. Excrement and refuse disposal unsatisfactory; no public scavenging anywhere in district. No voluntary Act adopted except Infectious Disease (Notification) Act, 1889. No licensing or regulation of slaughter-houses, dairies, cowsheds, milkshops, or bakehouses. Although the district essentially engaged in dairy industry, grave and dangerous defects in such arrangements generally.

8. CHELMSFORD RURAL DISTRICT (ESSEX); population (1891), 23,174; Dr. Fletcher.

Authority concerned: Chelmsford Rural District Council.

Ground of Inquiry: Joint tenure, by one person, of the offices of Surveyor of Highways and Inspector of Nuisances for the whole district.

Chief Facts reported by Inspector: Area of the district, 79,413 acres. Length of district roads, 260 miles. From preliminary inquiries it was found that in place of the late Inspector of Nuisances, who also had held office as District Surveyor and as Surveyor of Highways, the

District Council had resolved to proceed to the appointment of three individuals to perform the several duties pertaining to those posts. In these circumstances inspection of the district was postponed. Owing to the prolonged illness of the late officer, it had for some sixteen months been deprived of efficient nuisance inspection and supervision.

9. **Coleford (Gloucestershire)**; population (1891), 2,450; Dr. Fletcher.

Authority concerned: Coleford Urban District Council.

Ground of Inquiry: Enteric fever.

Chief Facts reported by Inspector: Coleford almost free from enteric fever from 1895 to 1898. During 1899 one case occurred in May, one other notified on July 20th. During the last twelve days of July, 19 cases notified, and during the first five days of August six additional cases. From July 20th to December 31st a total of 74 cases occurred in the Coleford Urban, and adjoining West Dean Rural, Districts, of which nine fatal. The outbreak appeared to have been intimately associated with one particular milk supply.

Sanitary circumstances of Coleford not satisfactory:—Public water supply good and ample, but not served to all houses in the district. Sewerage and drainage arrangements very unsatisfactory. Excrement and house refuse disposal and removal need much improvement. No isolation hospital or disinfecting apparatus. District Council remiss in the performance of their duties.

10. **Consett (Durham)**; population (1891), 8,175; Dr. Wheaton.

Authority concerned: Consett Urban District Council.

Ground of Inquiry: Complaints regarding the work of the Medical Officer of Health, especially as regards dealing with cases of infectious illness.

Chief Facts reported by Inspector: Certificates received under the Infectious Disease (Notification) Act, 1889, not been retained by the Medical Officer of Health; not entered in any register; imperfectly filled up in many cases. No information given by sanitary department to school teachers regarding infectious illness occurring in families members of which were attending school. In an epidemic of scarlet fever in 1898 in which 140 attacks occurred, two sufferers only were removed to hospital. Disinfection of dwellings very imperfectly performed; frequently left to householders. Scavenging not satisfactorily performed by the contractor. Isolation hospital provided, with disinfecting apparatus at the hospital. The Inspector of Nuisances little experienced: no record kept of complaints of nuisances, nor of action taken on complaint. No legal proceedings for repression of nuisances taken for many years, although many nuisances exist in the district. Three-fourths of the dwellings in the district belong to the Consett Iron Company.

11. COSELEY (STAFFORDSHIRE); population, 22,000; Dr. Darra Mair.

Authority concerned: Coseley Urban District Council.

Ground of Inquiry: Enteric fever—Registrar-General's Returns.

Chief Facts reported by Inspector: Population very scattered; grouped in various townships or villages. Overcrowding of houses on area and back-to-back houses notable in three of the latter, but not elsewhere. Much fouling of ground surface near houses, due to absence or imperfection of rain gutters and spouting, and to want of paving in back yards. Yards drained by surface channels or not drained at all. Majority of houses with privy vaults and separate large ashpits; few midden privies and no water-closets. Scavenging done by District Council; Inspector of Nuisances responsible; staff inadequate and work inefficient. Practically no sewerage. Pollution of water courses in the district. Surveyor has reported that sewerage is impracticable owing to scattered population and subsidences of ground which occur from time to time as result of coal mining. Boundaries of three public water supply areas meet in the district; but also a considerable number of private wells, especially near meeting point of the above boundaries. Wells usually dangerously near privies or slop water channels. Antiquated building byelaws; very little supervision of building construction. Sanitary staff inadequate; time of Inspector of Nuisances almost wholly occupied in scavenging operations. No isolation hospital; a house bought for this purpose has been occupied by the Surveyor for several years.

Enteric fever very prevalent in the district in the latter half of 1898; especially in Cinderhill, Bradley, and Wallbrook, places widely separate. In Wallbrook fever not traceable to water, milk, or sewerage, but apparently fostered by extremely filthy surroundings and dense population especially characterising that part of the district. In the other two townships the fever was, in each, mainly due to water derived from one infected well.

12. DARTFORD REGISTRATION DISTRICT (KENT); population (1891), 68,702; Dr. Sweeting.

Authorities concerned: Dartford Rural, and Dartford, Erith, and Bexley Urban, District Councils.

Ground of Inquiry: Persistent prevalence of diphtheria—Registrar-General's Returns and annual reports of local Medical Officers of Health.

Chief Facts reported by Inspector: Diphtheria imported at various times and in different ways and spread usually by personal infection. In the first three districts above-named spread of the disease largely aided by school operations. Insanitary conditions exerted no direct share in spread or fatality. Diphtheria kept alive by intermediate minor sore throat. Chronic enlargement of tonsils to be considered in this relation.

No proper disinfecting apparatus in use. Hospital accommodation inadequate. Much nuisance from keeping of animals in uncleanly manner close to houses. Abundant pollution of Rivers Darent and Cray flowing through the registration district. River Darent used in places for drinking and passes over water-cress beds.

Special sanitary circumstances and administration: (a) *Dartford Rural District.*—Much old cottage property; large portion supplied by the Kent Water Company, but many wells remaining, shallow and deep, liable to pollution; most of the district unsewered and drained to cesspools; many pit privies; few proper receptacles for refuse; scavenging by contract badly carried out; no byelaws for slaughter-houses and common lodging-houses; dairies, cowsheds, and milkshops not registered. Public Health Acts Amendment Act, 1890, not adopted, nor Infectious Disease (Prevention) Act, 1890. No action under Housing of the Working Classes Act, 1890. Hospital isolation and school-closure resorted to for diphtheria; but in some parishes the latter too partial and restricted.

(b) *Dartford Urban District.*—Much old cottage property; a few deep and Abyssinian tube wells, but nearly all the district supplied by the Kent Water Company; defective sewer flushing; inadequate supervision of dairies, cowsheds, and milkshops, and of common lodging-houses; byelaws for new streets and buildings obsolete. Infectious Disease (Prevention) Act, 1890, not adopted. No action taken under Housing of the Working Classes Act, 1890.

Hospital isolation and school closure resorted to for diphtheria; bacteriological examination as regards every child before return to school. But closure should have been for a longer period and should have been repeated.

(c) *Erith Urban District.*—A few deep wells remaining, but most of the district supplied with Kent Company's water; new sewerage system recently established, but new sewers deficient in flushing and ventilation, and house connections proceeding very slowly; several local sewers discharging on to Thames foreshore; old house drains badly ventilated; many water-closets inadequately flushed; scavenging imperfect. Action has been taken under the Housing of the Working Classes Act, 1890.

No hospital isolation for diphtheria before 1898, and only a few cases isolated since then. No school closure at all; house disinfection altogether perfunctory.

(d) *Bexley Urban District.*—Much old cottage property; no sewerage in Bexley Heath Ward; nearly the whole district supplied by Kent Company's water; many water-closets insufficiently flushed. No action yet under the Housing of the Working Classes Act, 1890.

Only two cases of diphtheria isolated in hospital since 1892. School closure not necessary.

13. FALMOUTH (CORNWALL); population (1891), 12,217; Dr. Buchanan.

Authority concerned: Falmouth Town Council.

Ground of Inquiry: Epidemic of enteric fever—local complaints.

Chief Facts reported by Inspector: General sanitary condition of borough in many ways unsatisfactory, *e.g.*, defects in house construction; badly paved yards; leaky sewers; faulty house drainage. Objectionable methods of sewage disposal on foreshore of Falmouth Harbour. Public water service from Falmouth Waterworks Company, which also supplies borough of Penryn. Opportunities of pollution of gathering ground of this company; filtration crude and insufficient. Supply in Falmouth periodically intermitted; pressure on high service supply inadequate; distributing pipes liable to choke from peaty matters in the water.

Enteric fever prevalent from end of 1898 to July 1899. In August and September 1899 a pronounced epidemic, continuing, though less severely, through October and November. In all 152 notified cases of enteric fever during eleven months of 1899. Incidence on locality and other circumstances of fever prevalence discussed. Consideration of various insanitary circumstances of Falmouth in relation to epidemic. Reasons for inferring that insuction of infectious matter into Falmouth water mains during periods of intermission of supply had concern with the epidemic which began in August.

14. IDLE (YORKS, WEST RIDING); population (1891), 7,118; Dr. Fletcher.

Authority concerned: Idle Urban District Council.

Ground of Inquiry: Joint tenure, by one man, of offices of Surveyor and Inspector of Nuisances.

Chief Facts reported by Inspector: Water from the mains of the Bradford Corporation. Excrement disposal mainly by privy ashpits and unsatisfactory. Removal of night-soil and house-refuse, performed by contract, apparently well attended to in the Thackley portion, and fairly well in the Idle portion of the district. Sewerage and drainage appear to be well designed and carried out. Extensions of sewers are in prospect. Idle, included in Calverley Joint Hospital District: population (1891) 36,243. Hospital erected for 24 beds. A temporary block added for small-pox. Slaughter-houses registered, generally in fair condition. Dairies, cowsheds, and milk-shops not registered; some unsatisfactory as regards construction and cleanliness. No common lodging-houses. (This district now forms part of the County Borough of Bradford.)

15. ILKESTON REGISTRATION SUB-DISTRICT (DERBYSHIRE); population (1891), 33,000; Dr. Wheaton.

Authorities concerned: Ilkeston Town Council, Heanor Urban, and Basford Rural, District Councils.

Ground of Inquiry: Prevalence of enteric fever—Registrar General's Returns.

Chief Facts reported by Inspector: Ilkeston.—Borough of Ilkeston not free from enteric fever since 1881. In 1894, three notified attacks and four deaths; in 1895, 24 attacks and four deaths; in 1896, 80 attacks and eight deaths; in 1897, 69 attacks and 13 deaths; in 1898, 112 attacks and 29 deaths. Fever prevalence in all probability due to pollution of the general water supply of the town, which is derived from the Nutbrook and imperfectly filtered. The water of the Nutbrook is grossly polluted by liquid refuse from dwellings at Heanor, effluent from the Heanor sewage farm, and numerous other sources of contamination. Enteric fever prevalent at Heanor, 2½ miles distant from Ilkeston; probably reciprocal transmission of enteric fever between the two places. Hospital provision inadequate. No disinfecting apparatus. Condition of dairies and cowsheds, slaughter-houses, common lodging-houses, and bake-houses very unsatisfactory in most instances. Sewerage complete, sewage disposal faulty. Scavenging performed by the Town Council.

Heanor: This urban district not free from enteric fever for many years. In 1894, 20 notified attacks and two deaths; in 1895, 26 attacks and four deaths; in 1896, 20 attacks and four deaths; in 1897, 52 attacks and 12 deaths; in 1898, 24 attacks and five deaths. Unwholesome conditions in the district so many and diverse that it is almost impossible to come to a definite conclusion as to operation of particular agencies of infection.

Probably some of the sufferers came by infection at Ilkeston.

Hospital provision merely a cottage; no disinfecting apparatus. Condition of cowsheds and dairies and of common lodging-houses unsatisfactory. Excrement disposal very faulty, by cesspit privies and midden privies. No regular system of scavenging. House drainage in many dwellings very faulty. Sewers laid, but sewage disposal very unsatisfactory, liable to cause pollution of watercourses from which Ilkeston water supply is derived. Water supply, very scanty, from public waterworks, supplemented by water from shallow wells liable to pollution, and from rain-water tanks.

Villages of Trowell, Cossal, and Shipley (Basford Rural District).—No enteric fever known in this part of the registration district for the last two years. The water supplies altogether distinct from those of Ilkeston Borough and Heanor Urban District. Isolation hospital and disinfecting apparatus available. Sewerage wanting in parts; sewage disposal and house drainage defective. Excrement disposal faulty; for the most part effected by means of midden privies. No systematic scavenging.

16. ST. DOGMELL'S RURAL DISTRICT (PEMBROKESHIRE); population, 9,125; Dr. Sweeting.

Authority concerned: St. Dogmell's Rural District Council.

Ground of Inquiry: Sanitary circumstances and administration, in reference to plurality of Medical Officers of Health.

Chief Facts reported by Inspector: Many cottages unfit for habitation. Proper drainage almost entirely absent. Water from springs liable to pollution; also contaminated surface water, shallow wells exposed to surface impurities, and open water-courses. Defective system of refuse disposal. No public scavenging. No urban powers obtained to enable Council to make byelaws for slaughter-houses. No registration or regulation of cowsheds, dairies, and milkshops. No isolation hospital, and no proper disinfection. Sanitary administration defective. District divided amongst two Medical Officers of Health, who rarely confer with each other or give concerted advice regarding the district as a whole.

17. SHIREBROOK VILLAGE (DERBYSHIRE); population (1891), 576; since increased to about 7,000; Dr. Copeman.

Authority concerned: Blackwell Rural District Council.

Ground of Inquiry: Prevalence of enteric fever.

Chief Facts reported by Inspector: Outbreak of 1899 differed from those of previous years by its greater extent and more general distribution. Type of epidemic mild: only seven deaths out of 130 recorded cases. Accuracy of diagnosis doubtful in some instances. Disease mainly spread by personal contact, though in addition there appeared reason for suspecting that the milk supply was concerned in causing extension of epidemic, more particularly in that portion of village owned by colliery company.

No hospital provision. Arrangements for scavenging inefficient. System of sewage filters on the colliery company's estate useless and productive of nuisance. Abandonment of present pail system of excrement removal and substitution of water-carriage system advised.

18. **South Witham (Lincolnshire)**; population (1891), 575; Dr. Bruce Low.

Authority concerned: Grantham Rural District Council.

Ground of Inquiry: Information of sudden fatal illness received from the Home Office, and from report by the Medical Officer of Health.

Chief Facts reported by Inspector: Complaint made to Home Office of four sudden deaths at a farm house in the village during a period of four weeks, and suggestion that the deaths were due to criminal irritant poisoning; a request put forward for exhumation of one or more bodies for analysis of contents of stomachs. Investigation made by County Coroner and the Lincolnshire Constabulary disproved the allegation of criminal poisoning, but showed grounds for the opinion that the deaths were due to specific fever. Subsequent inquiries showed that these cases formed part of an outbreak of anomalous enteric fever, comprising 33 cases, only 13 of which, and those only towards the end of the outbreak, were notified. Only two out of eight deaths ascribed to the current malady were certified as enteric fever. Many of the cases ran an irregular and anomalous course; some were characterised by marked cerebro-spinal symptoms. In some instances the illness attacked those engaged in nursing the sick. In some others the diffusion of the disease appeared to be associated with infected milk from the farm house already mentioned; and another group apparently was due to the pollution of a surface-spring by bowel discharges thrown on a dungheap and soaking into the subsoil from the implicated farm house. The water supply of the village is from local wells liable to pollution. There is no sewerage, and excrement disposal is by means of cesspit privies. The extreme fatality of the illness in the farm house due to imprudent exposure during course of the disease.

No. 7.

APP. A. No. 7.

On Enteric Fever in Chichester; by Dr. Thomson and Colonel Marsh.

REPORT on ENTERIC FEVER in the CITY OF CHICHESTER; by Dr. THEODORE THOMSON and COLONEL J. T. MARSH, R.E.

THE city of Chichester, in the county of Sussex, has, on several occasions, attracted attention by reason of its liability to repeated recurrence of enteric fever in serious amount. Thus, in 1865, Dr. Seaton, in a report to the Privy Council on "Circumstances Endangering the Public Health of Chichester," called attention to the frequency with which outbreaks of enteric fever were wont to occur in this district. Again, in 1878, Dr. Airy, in a report to the Local Government on "An Outbreak of Enteric Fever in Chichester," alludes to the persistence of a high death rate from this cause in the locality. Yet again, in 1896, Dr. Bulstrode, in a report to the Local Government Board upon "Prevalence of Enteric Fever in the City of Chichester," points out that "in the decennium 1871-80 there were, "excluding a few districts in which alterations had been effected, only "some 31 out of 630 districts in which the combined enteric and continued fever rates were higher than those of Chichester; and "similarly in the next decennium there were but sixteen districts out "of the 631 in England and Wales which had higher rates in this "respect than Chichester." It may be noted that the occasion of Dr. Bulstrode's investigations in 1896 of prevalence of enteric fever in Chichester, was the occurrence in that year of a serious outbreak of the disease there.

In 1897 there was again notable recurrence of enteric fever in Chichester; and, as result, certain residents in the district presented to the Mayor a memorial containing request that he should "take "immediate steps to obtain an independent inquiry into, and a report "upon, the prevalence of enteric fever in the city, by an experienced "engineer and medical officer."

On June 13th, 1898, the Board received from certain inhabitants of Chichester a petition setting forth that an inquiry, such as requested in the memorial to the Mayor, by an engineer and a medical officer, was urgently called for. "Not," continued the petitioners, "a formal "inquiry, costing money and stirring up strife, but a walking inquiry "by scientific experts accessible to all and anxious only to arrive at "the truth." The petitioners therefore prayed the Board "either to "make such inquiry, or to take some other step to ascertain the reason "of the outbreak of typhoid fever, and to apply the necessary remedy."

Thereupon we were instructed by the Board to make inquiry into the circumstances attending the frequent recurrence of enteric fever in the city of Chichester.

To this end we visited Chichester on August 3rd, 1898, and on many subsequent occasions, making inquiry in the sense indicated. The facts and considerations that appear to us to bear upon the subject of our inquiry are hereinafter set out at length; saving those conditions, topographical, geological, or sanitary, of which account has been given by Dr. Bulstrode in his report already referred to. (*See* Addendum C. to this Report.) To these matters but brief reference will now be made, except as regards the system of sewerage of the district, which will be treated of by us in some detail. Any changes, also, that have come about in any of the above-mentioned conditions since the date of Dr. Bulstrode's inquiry, will be duly noted.

The city of Chichester had, at the census of 1891, a population of 7,830 persons upon an area of 722 acres. Since 1891, however, the city boundaries have twice been extended; in 1893, and again in 1895. The present area of the district is 1,595 acres, while the population is locally estimated as having been about 11,500 in the middle of 1898. Chichester stands on ground which is for the most part flat or slopes but slightly, the main direction of slope being from north to south. The soil underlying houses is, in most instances, coarse gravel of varying and, commonly, uncertain depth; which gravel overlies the clay of the London and Reading Beds.

Water supply is derived partly from private wells, partly from a public service in the hands of the Corporation. This public supply is obtained from two wells situated about one and a half miles to the west of Chichester, and near the village of Fishbourne. One of these wells was sunk in 1874, and is described by Dr. Bulstrode in his report. (*See* Addendum C.) The other was sunk in 1898, and is 120½ feet in depth. The upper 16½ feet of this well are lined with brickwork in cement, 14 inches in thickness, and surrounded by clay puddle two feet in thickness. Below the brickwork the well is lined for a further depth of 50 feet with cast-iron cylinders.

In sinking the well, the following layers were encountered:—

	Feet.
Mould	1
"Gravelly loam"	1½
"Porous shingle"	1½
Clay and gravel	2
Reading clay	22
Clay and Chalk	4
Chalk with flints	88½

Both wells are situated near the southern margin of the Reading Beds, the Chalk coming to the surface along this margin and within a few yards of the wells.

Excrement disposal in Chichester is effected partly by the water-carriage system, partly by cesspit privies. Water-closets drain either to sewers or to cesspools. Since 1896 there has been progressive reduction alike of the number of houses draining to cesspools,

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and of those furnished with cesspit privies, with corresponding increase in the number of houses fitted with water-closets draining to sewers. Thus, in the middle of 1898 nearly three-fourths of the houses in Chichester drained to sewers; whereas in 1896, Dr. Bulstrode stated that "only a limited "number of houses were connected with the sewers." More detailed information on this matter will be found at a later stage of this report.

The sewerage scheme, as shown in Map F., was carried out in 1893-95, and no important deviations from the original plan have been discovered by us. The sewage gravitates to the outfall works, which are situate on the banks of the Fishbourne Channel, about 1½ miles south-west of Chichester Cross. The sewage is there treated with sulphates of lime and alumina in three precipitation tanks, each having a capacity of 34,375 gallons. The tank effluent is passed over some six acres of land, underdrained at a depth of three feet, and the "land effluent" passes into a cement-lined tidal basin having a storage capacity of 320,000 gallons. Two precipitation tanks are worked at a time, hence their capacity and that of the tidal basin equal 388,750 gallons. In normal weather the basin is emptied into the Fishbourne Channel every second tide during the first three hours of ebb. The normal dry-weather flow is regarded as 250,000 gallons.* But we learned that considerable difficulty has been experienced at the disposal works in dealing with the large volume of subsoil water which at times finds its way into the sewers.

The following record of the average daily flow of "sewage" at different periods of the year has been compiled from statistics furnished by the manager of the Corporation's outfall works:—

Year.	Month.	Average daily flow of Sewage.	Year.	Month.	Average daily flow of Sewage.
1895	October ...	166,500 gallons.	1897	August ...	623,570 gallons.
"	November	342,760 "	"	September	583,400 "
"	December	477,660 "	"	October ...	643,760 "
			"	November	302,200 "
1896	April ...	835,260 "	"	December	273,120 "
"	May ...	1,017,500 "			
"	June ...	764,600 "	1898	January ...	271,830 "
"	July ...	474,300 "	"	February	276,840 "
"	August ...	310,830 "	"	March ...	262,080 "
"	September	454,890 "	"	April ...	246,280 "
"	October ...	615,000 "	"	May ...	254,780 "
"	November	565,800 "	"	June ...	249,650 "
"	December	1,108,800 "	"	July ...	269,680 "
			"	August ...	282,880 "
1897	January ...	2,011,300 "	"	September	277,770 "
"	May ...	1,731,400 "	"	October ...	284,850 "
"	June ...	1,521,700 "	"	November	272,850 "
"	July ...	993,870 "	"	December	278,120 "

From the large quantities of subsoil water admitted *into* the sewers, as indicated above, some idea may be formed of the amount

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* Exclusive of the daily flow of trade effluents to the sewers, viz.:—

	Gallons.
Tannery	6,300
Brewery	40,000

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of sewage which may possibly leak *from* the sewers into the subsoil when the conditions are favourable.

A good deal of patching and repairs have been carried out since the sewers were laid, with a view of excluding the subsoil water. The pipes are stated to have been provided with patent joints; however, it was admitted that in many cases they were laid in flooded trenches, hence the leakages are not to be wondered at.

We were informed that during the years 1897-8 leaky sewers were rectified at the following twenty-nine places:—

Leaks.	Locality.	Position.
1	Franklin Place	59ft. from B. 11 towards L. 1.
1	Junction of New Park Road with Franklin Place	Manhole L. 2.
1	North Gate	118 ft. from B. 10 towards B. 9.
1	St. Paul's Road	39 ft. „ B. 9 „ J. 1.
1	Orchard Place	24 ft. „ B. 7 „ B. 6.
1	Do.	165 ft. „ B. 6 „ B. 7.
1	Do.	3½ ft. „ B. 6 „ B. 7.
1	Do.	66 ft. „ B. 5 „ B. 6.
1	Do.	19½ ft. „ B. 5 „ B. 6.
1	Orchard Street	39 ft. „ B. 5 „ B. 4.
1	Do.	20 ft. „ B. 5 „ B. 4.
1	Orchard Terrace	39 ft. „ B. 8 „ B. 7.
1	Do.	48 ft. „ B. 7 „ B. 8.
1	Junction of West Lane with Orchard Terrace ...	Manhole G. 1.
1	Westgate	6 ft. from B. 4 „ B. 3A.
1	Do.	27½ ft. „ B. 3A „ B. 3.
1	Whyke Road	7 ft. „ M. 7 „ M. 6.
1	Do.	70 ft. „ M. 5 „ M. 6.
1	Do.	5½ ft. „ M. 5 „ M. 4.
1	Do.	Manhole M. 5.
1	Do.	Do. M. 6.
1	Do.	Do. M. 7.
1	Junction of Bognor Road with Whyke Road...	Do. N. 2.
1	Canal Wharf	Do. M. 1.
1	Whyke Fields	Do. M. 3, No. 296, Ordinance Map.
1	Do.	Do. M. 4, do.
1	Do.	114 ft. from M. 3 towards M. 4.
1	York Road	110 ft. „ M. 9 „ M. 10.
1	Do.	Manhole M. 10
Total 29		

The manholes we inspected appeared to be well constructed, but in three cases we found that the sewers leading from the manholes were defective, viz., one in the Hornet, to the east of the town, marked B on map F; one at C, south of the railway station; and one at Old Place, south-east of the town, marked A on map.

According to the deposited plans, the gradients of the sewers are good, inasmuch as the velocities, when running half full, would not be less than 2½ feet per second, which may be regarded as rendering the sewers self cleansing. If the original scheme has not been departed from, the sewers have sufficiently good gradients; and if any defects now exist they must be due to faulty construction and to the fact

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that some of the pipes were submerged when they were laid. (*See* ante.)

There is no systematic ventilation of the sewers by ventilators at the street level, but ventilating shafts have been provided. The shafts are 30 feet high, and about 300 yards apart.

There are seventeen 500-gallon flushing tanks. The contents are discharged by 6-inch siphons in about three minutes. Fifty dead ends of the sewers are flushed weekly by vans, each capable of holding 450 gallons. The sewers along the route are also flushed by damming up the sewage at various points in the system. Generally, the flushing arrangements seem to be satisfactory.

On the occasion of our visit in November, 1898, there were over 500 houses not drained to the sewers, although in each instance a drain had been carried from the sewer towards the house as far as the footway, and an intercepting trap provided. The iron grating forming the air-inlet for each house drain invariably coincides with the kerb in the footway, and this must act as a sewer ventilator where the house connection has not been made. We heard of many complaints about offensive smells from these intercepting traps on the footways.

Fever prevalence in Chichester.

The following table (Table I.) shows the number of deaths referred to enteric and continued fevers in the area now comprised by the city of Chichester, year by year, during the 29 years 1870-98.

TABLE I.

SHOWING, year by year, for the period 1870-98, the NUMBER of DEATHS referred to ENTERIC and CONTINUED FEVERS, in the area comprised by the present city of Chichester.*

Year.	Number of Enteric Fever Deaths.	Number of Continued Fever Deaths.	Year.	Number of Enteric Fever Deaths.	Number of Continued Fever Deaths.
1870	3	2	1885	3	...
1871	3	1	1886	4	...
1872	3	2	1887	2	...
1873	4	1	1888	5	...
1874	3	1	1889	1	...
1875	5	...	1890	...	...
1876	7	3	1891	...	...
1877	3	...	1892	3	...
1878	6	1	1893	...	...
1879	8	...	1894	...	...
1880	5	...	1895	...	...
1881	2	1	1896	2	...
1882	4	...	1897	6	...
1883	6	...	1898	13	...
1884	7	...			

Total Deaths from Enteric Fever 1870–98 108
Do. do. Continued Fever do. 12

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* Deaths from enteric or continued fever, of persons imported into public institutions in Chichester from other districts, are not included in this table.

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From this table it appears that during these 29 years 108 deaths were referred to enteric fever, and 12 deaths to continued fever, within the area now comprised by the city of Chichester. There has been, it will be observed, considerable variation as regards the number of deaths referred to those causes in one and another year. This feature extends not merely to individual years, but even to periods of years. There is, for instance, notable contrast between the period 1890-95, on the one hand, and 1876-80, or 1896-98, on the other hand. These instances of rise and fall of fever mortality in Chichester are also illustrated in the following table (Table II.), in which the 28 years 1871-98 are grouped in six periods, for each of which is shown the annual death-rate from enteric fever per 1,000 persons living in Chichester; while, for purposes of comparison, like data are furnished for England and Wales as a whole.

TABLE II.

SHOWING, for each of six periods of years, the NUMBER of DEATHS from ENTERIC FEVER, and the annual death-rate per 1,000 living in Chichester from this cause; together with the death-rate from the same cause in England and Wales.

Period.	City of Chichester.			England and Wales; Enteric Fever Death Rate per 1000 living.
	Estimated Population.	Enteric Fever Deaths.	Enteric Fever Death Rate per 1000 living.	
1871–75	7,890	11	0·28	0·37
1876–80	8,020	26	0·65	0·28
1881–85	8,040	17	0·42	0·22
1886–90	7,920	12	0·23	0·18
1891–95	7,760	3	0·08	0·17
1896–98	11,000	21	0·64	0·17

In this table deaths from enteric fever only are reckoned; deaths from continued fever are omitted. Deaths from enteric fever, of persons imported from other districts into public institutions in Chichester, are not included in this table.

It will be observed that the number of deaths from enteric fever is smaller than in Table I. This is because Table I. deals with the extended area comprised in the present City of Chichester, whereas in this table the deaths included anterior to 1893 are those only that occurred in the smaller area that formed Chichester before extension of its boundaries took place. The reason for not dealing throughout, as in Table I., with the larger area is that it was found difficult to ascertain the population of this larger area before it became entirely included in Chichester, and correspondingly difficult, therefore, to arrive at trustworthy estimate of enteric fever death rates in this larger area.

From this table it appears that, during the quinquennium 1871-75, the mortality from enteric fever in Chichester was lower than in England and Wales as a whole. In the following quinquennium, however, the death-rate from this cause in Chichester rose far above that of the country as a whole, and did not again fall below that level until 1891-95. This improvement in 1891-95, however, was followed during the period 1896-8 by reversion of Chichester to an enteric fever mortality much higher than that of the country as a whole, the annual death-rate from this cause during that period in the city being 0·64 per 1,000 persons living, while that of England and Wales for the same period was but 0·17 per 1,000 persons living.

Further measure of the prevalence of enteric fever in Chichester in recent years is afforded by the returns of *cases* of this disease notified as having occurred within the district since 1890, in which year the Local Authority adopted the Infectious Disease (Notification) Act, 1889. The following list shows the number of these cases notified year by year during the nine years 1890-98, exclusive of cases of the disease imported into public institutions in Chichester from other districts:—

1890	7
1891	1
1892	7
1893	7
1894	1
1895	2
1896	116
1897	129
1898	100

During the five years 1893-97 the mean attack rate from enteric fever in fifty towns in England and Wales is calculated, from returns of notified cases of the disease, to have been 1·03 per 1,000 living per year, while the attack-rate from this disease in Chichester, during the six years 1890-95, was, as may be estimated from the above list, little more than 0·5 per 1,000 yearly. The enteric fever attack rate in Chichester, therefore, during these six years, compares favourably with that of the fifty towns referred to, during the period 1893-97. But in 1896, 1897, and 1898, there was enormous increase in enteric fever prevalence in Chichester, the attack rate from this cause reaching 10·7, 11·4, and 8·7 per 1,000 in these years, respectively.

As regards enteric fever in Chichester prior to 1870, we give no details; noting merely that this fever is known to have been unduly prevalent in the district anterior to that date. That this was so appears from the report made to the Privy Council in 1865 by Dr. Seaton, already alluded to. In that report it is stated that, in Chichester, "diseases directly associated with unwholesome conditions, especially "gastric, enteric, or typhoid fever, are never long absent, and sometimes "considerably prevail."

It would seem, accordingly, that Chichester has long been noted as exceptionally liable to occurrence of fever in serious amount; but that extra prevalence of fever has occurred at uncertain intervals, there having been, in the past, groups of years characterised by heavy mortality from fever, alternating with other groups of years in which there was relatively small amount of fatal fever.

As with the incidence of the fever in time, so also as regards its incidence on locality; the fever within the area comprised by the

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present city of Chichester has been irregularly distributed. This will appear on study of the appended spot-maps showing

(1.) The distribution of known cases of enteric fever during each of the three years 1896, 1897, and 1898. (Maps A, B, and C.)

(2.) The distribution of deaths referred to enteric and continued fevers during (*a*) the period 1870-84 (Map D), and during (*b*) the period 1885-98 (Map E).

On reference to maps A, B, and C, on which is shown the distribution of known cases of fever in Chichester in each of the years 1896, 1897, and 1898, it will be observed that during those years the fever manifested marked preference for certain localities; and that these localities were much the same in each year. All these localities lie outside that portion of Chichester which is within the line of the old city walls, and are as follows:—

(1.) Somerstown, with some 300 houses (enclosed by a blue line on maps).

(2.) The neighbourhood of Orchard Street and Franklin Place, comprising about 180 houses (enclosed by a green line on maps).

(3.) St. Pancras and the Hornet, comprising about 250 houses (enclosed by a brown line on maps).

(4.) A group of houses in Portfield, about 330 in number (enclosed by a purple line on maps).

It appears also from these maps that the portion of Chichester that lies within the line of the old city walls (enclosed by a pink line on maps), comprising about 680 houses, suffered but little from the fever during the three years in question.

But examination of maps D and E, on which is shown the distribution of deaths referred to enteric and continued fevers during the consecutive periods 1870-84 and 1885-98, tends to suggestion that the distribution of these fevers in the past has not always accorded, as regards locality, with that indicated by maps A, B, and C, as having been manifested in 1896, 1897, and 1898. Map E, which deals with the period 1885-98, does indeed point to a distribution of the disease like to that indicated in maps A, B, and C; but study of map D, which has to do with the period 1870-84, suggests that the distribution of enteric and continued fevers, as evidenced by deaths from these diseases,in that period differed materially from their distribution in the period 1885-98. For in the former period, the area within the line of the old city walls, so far from exhibiting that comparative immunity from the fever which it appears afterwards to have exhibited, would seem to have suffered from it in nearly as great degree as those areas without the line of these walls that have been noted as suffering heavily in 1896, 1897, and 1898.

The distribution of the fever indicated by these maps is set out, as regards the periods under consideration, in the following table (Table III). A chart also is annexed (Chart I.), showing the number of deaths from enteric and continued fevers in Chichester year by year during the period 1870-98 within and without the line of the old city walls.

TABLE III.

SHOWING for the whole of CHICHESTER, and for each of certain areas in CHICHESTER, the total number of houses, and the number of such houses known to have been invaded by ENTERIC FEVER in 1896, 1897, and 1898; and showing also the number of DEATHS referred to Enteric and CONTINUED FEVERS in each area during each of the periods 1870–84 and 1885–98.

Area.	Total Number of houses (1898).	Number of houses known to have been invaded by Enteric Fever in			Number of deaths referred to Enteric and Continued Fevers during	
		1896.	1897.	1898.	1870–84.	1885–98.
Within the old walls ...	682	4	6	13	22	2
Somerstown	303	18	36	8	8	11
Portfield	335	13	26	21	11	7
St. Pancras and The Hornet	253	21	12	9	11	6
Orchard Street and Franklin Place.	180	11	10	10	5	3
Other areas	817	12	11	16	24	10
The whole of Chichester	2,570	79	101	77	81	39

From this table it appears that during the period 1870-84, 81 deaths were referred to enteric and continued fevers in the district comprised by the present city of Chichester, and that during the following period, 1885-98, no more than 39 deaths were referred to these fevers in this district. Further the table shows that of the 81 that occurred during the earlier period, 22 were deaths of persons residing within the line of the old city walls, and 59 were deaths of persons residing without the line of those walls; whereas of the 39 fever deaths during the later period, only two were deaths of persons residing within the line of the old city walls. It has to be borne in mind, indeed, that during the earlier period, the population within the line of the old walls amounted to more than one-fourth of the total population of the district comprised by the present city; but, even if it be taken as having been nearly one-third of this total population, it will be seen that the proportional incidence of fatal fever at that time on the area within the walls was nearly as great as on the areas without the walls. In the later period, the proportion of total fever deaths that occurred within the walls was on the contrary small and inconspicuous. This change of incidence of fatal fever within the limits of the district is also shown, in graphic form, by the accompanying chart. (Chart I.) As regards local distribution of the fever prior to 1870, it is noteworthy that Dr. Seaton, in his report to the Privy Council, already quoted, states that it was most prevalent about Somerstown, and that "parts of St. "Pancras were scarcely less bad." From which it would seem probable that at this still earlier period the local distribution of the fever differed from that of the intermediate period, 1870-84, and bore resemblance rather to that which characterised the later period, 1885-98.

Causation of the Fever.

It appears from the foregoing account that in looking for an agency or agencies which shall be held as satisfactorily accounting for fever prevalence in Chichester, several considerations must be borne in mind. First of these is the fact that undue fever prevalence in Chichester is no new thing, and therefore that explanation of former as well as of recent occurrences of high mortality from this cause is necessary to satisfactory solution of the problem of its causation. It may indeed be that, apart from limited occurrences of fever due to temporary conditions, the more permanent persistence of fever in serious amount in Chichester has been due to more than one agency. This possibility has especially to be borne in mind in regard of the recent re-appearance of fever in epidemic form in the district after a considerable period of comparative quiescence.

It has also to be borne in mind that the fever in Chichester has varied very considerably in amount from time to time, and that, since 1870, there have been two groups of years during which the death-rate from this cause has been below that of England and Wales. In view of the small size of the district and of the population concerned, less significance may be held to attach to this consideration than would otherwise be the case; it is, nevertheless, not devoid of importance. The proclivity of the fever for particular quarters of Chichester has also to be remembered. In this connection the special incidence of the fever on certain areas in Chichester recently manifested in three successive years, as also the diversities of its localisation in earlier years and in recent years, more particularly call for consideration. As with distribution in time, however, so also with distribution in place, the smallness of the areas and populations concerned must not be lost sight of as tending to qualify the value of induction from data of this sort.

With these considerations in mind, the possible agencies of fever prevalence in Chichester may be reviewed in the following order:—

1. Foods (milk; shellfish).
2. Water.
3. Sewerage.
4. Rainfall and subsoil water.
5. Other agencies.

Foods.

Under this heading milk and shellfish will be considered briefly in their possible relationship with fever in Chichester. It is not suggested that either milk or shellfish is to be regarded as an agency accounting for the continuance of unusual amount of fever in Chichester over many years; rather these articles of food require consideration as possibly having had occasional relations of causative sort with fever prevalence. Thus, as regards milk, it appears that in the spring of 1879 an outbreak of enteric fever occurred, regarding which local inquiry was made by Dr. Airy, at that time one of the Board's inspectors. Dr. Airy, as result of his investigations, came to the conclusion that this outbreak was due to infective material conveyed in milk. In all some 50 persons were attacked, and six died. These six persons resided in Westgate and Orchard Street, just without the city walls, and may be noted as mainly constituting the clump of spots shown in and near the Westgate in map D.

There is no record of milk having given rise to other occurrence of fever in Chichester in serious amount during the period 1870-98. In 1896, Dr. Bulstrode made careful investigation in this sense, but found no evidence that milk had had concern with the prevalence of fever in Chichester that year. Like investigation made by us regarding the fever of 1897 and 1898, failed to show any relation between milk and the disease. In both those years the milk supplied to houses invaded by the fever was obtained from some twenty different sources, and in no instance was there special incidence of fever upon houses furnished with milk from any one of these twenty sources.

As regards possible relation between fever and shellfish, the only evidence we have been able to obtain has concern with the outbreak in 1898. In that year 100 cases of enteric fever are known to have occurred in Chichester. In eighteen of these cases there is history of the attacked persons having consumed cockles, and of this meal having been followed on the same day or on the next day by vomiting and diarrhœa. These symptoms, it is stated, became gradually more marked, and, some ten days after eating the cockles, enteric fever was diagnosed by the medical attendant. But the evidence available, while not inconsistent with the thesis that in some cases the infective material of the fever had been conveyed by cockles, was insufficient to warrant definite conclusion on this subject. It is noteworthy, however, in this connection that many cockles sold in Chichester are derived from mud-flats liable to pollution by sewage; and that the process of cooking to which these shellfish are subjected seldom, if ever, is such as can be trusted to destroy enteric fever bacilli in their interior. Be this as it may, the suggestion of relationship between cockles and enteric fever in 1898 extends to less than one-fifth of the cases known to have occurred in that year.

WATER.

At the present time Chichester is furnished with water partly from a public supply, partly from private wells. The analyses, chemical and bacteriological, that have been made of the public supply are consistent with purity of the water, although the circumstances and surroundings of the sources of this supply are not quite satisfactory. The two wells from which the water is pumped are indeed sunk through the Reading Beds to the Chalk, but they are within a few yards of the margin of the Reading Beds, and at this margin the Chalk comes to the surface. Just where the Chalk comes to the surface is a stream polluted by sewage; a condition of things which cannot but be regarded as involving some risk of pollution of the water pumped by the Chichester Corporation from these two wells. The domestic wells that form the remainder of the Chichester supply are sunk in the gravel on which the town stands, and are, by their position and structure,

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liable, in most instances, to dangerous pollution. Annexed to this report will be found chemical analyses by Sir Edward Frankland, F.R.S., of two samples of well-waters taken by one of us on November 12th, 1898. (*See* Addendum A.) It will be seen that in both instances the analysis indicates a water so polluted as to be unfit for domestic use.

Prior to 1874 the whole of the area comprising the present district of Chichester was supplied with water from domestic wells. In 1874 water began to be furnished from one of the wells constituting the present public supply; water from the other well was first supplied in July, 1898. By 1896 little more than half the houses in Chichester were being furnished with water from the public supply. If, therefore, water has played material part in distribution of fever in Chichester, this part, prior to 1874, had concern, not with the public water supply, which was then non-existent, but with domestic wells only. There was much fever in Chichester for a considerable number of consecutive years after 1874, but there is no evidence as to what proportion of fever cases occurred in houses furnished with the public supply as compared with those having local wells. Evidence of this sort, however, is available for each of the three years, 1896-8. As regards 1896, Dr. Bulstrode notes that 2·6 per cent. of houses furnished with the public water supply were invaded by enteric fever; while 2·9 per cent. of houses with shallow well water were similarly invaded. That is to say, in 1896 the proportional incidence of fever on the two classes of house was practically the same. The following statement indicates what was the incidence of the fever on each of these two classes of house in 1897 and in 1898:—

1897.—Total number of houses in Chichester on July 1st, 1897, 2,540.
    Number of these houses with public water supply, 1,638.
    Number of these houses supplied by local wells, 902.
    Number of houses with public water supply invaded by enteric fever, 68, or 4·1 per cent.
    Number of houses supplied by local wells invaded by enteric fever 33, or 3·6 per cent.

1898.—Total number of houses in Chichester on June 1st, 1898, 2,570.
    Number of these houses with public water supply, 1,705
    Number of these houses supplied by local wells, 865.
    Number of houses with public water supply invaded by enteric fever, 44, or 2·6 per cent.
    Number of houses supplied by local wells invaded by enteric fever, 32, or 3·7 per cent.

From the foregoing figures it will be seen that in 1897 the proportional incidence of enteric fever on the two classes of house differed but little, and that in 1898, although the resemblance in amount of incidence was not so close, yet the difference was not such as to suggest that one class of water supply had had material concern with dissemination of the fever rather than the other. An hypothesis that in each of these years both the public water supply, and a considerable number of local wells situated widely apart, simultaneously became vehicles for transmission of the infective material of enteric fever, is too remote from probability to require serious consideration. There is not, therefore, ground for belief that water played any notable part as a fever agency in Chichester during the years 1896-8. It is, however, more difficult to arrive at conclusion as to the share water may have had in dissemination of fever in Chichester in years anterior to 1896, and this, because, as already stated, evidence of the sort available for the period 1896-8 is lacking as regards earlier years. It may, indeed, be assumed that for a considerable number of years after 1874, when a public water supply was introduced to the district, most houses continued to derive their water supply from shallow wells, many of them liable to dangerous pollution, a condition of things sufficiently likely to conduce to undue prevalence of enteric fever. It is, however, open to doubt whether, if water had been the main agency of fever dissemination during those earlier years, the very small proportion of deaths from this cause in the area within the line of the old city walls in later years —as for instance during the period 1885-98—was to have been looked for co-incidently with serious prevalence of fatal fever in other areas in Chichester. For within the old walls, even so recently as 1898, there were no fewer than 120 wells (out of a total of 474 in the whole district), of which the water was the sole supply available to certain premises for domestic purposes; and it may reasonably be supposed that, in years before 1898, the number of such wells within the walls was still greater.

SEWERAGE.

Prior to 1895 all houses in Chichester were either undrained or were drained to cesspools. The present sewerage system of the district was commenced in September, 1893, and was not completed until 1895; the first connection of any house to the sewerage system being made in March of the latter year.

So far, therefore, as undue prevalence of fever in Chichester is concerned, the sewerage system as an agency is excluded, unless in the three years 1896-8. If the sewerage system has had material share in propagation of enteric fever in these three years, it may be held that there would be likely to have been a materially greater incidence of the disease on houses connected with the sewers than on those not so connected. As to this the facts are as follows: In regard of fever in 1896, Dr. Bulstrode found that "the percentage incidence on the "whole of the undrained houses in the town was slightly in excess of "that upon the whole of the drained houses."

As regards fever in 1897 and 1898 the following figures show the relative incidence of the disease on houses draining to the sewers and houses not so drained:—

1897.—Total number of houses in Chichester on July 1st, 1897, 2,540.
Number of these houses drained to sewers, 1,493.
Number of these houses not drained to sewers, 1,047.
Number of houses drained to sewers invaded by enteric fever, 72, or 4·8 per cent.
Number of houses not drained to sewers invaded by enteric fever, 29, or 2·8 per cent.

1898.—Total number of houses in Chichester on June 1st, 1898, 2,570.
Number of these houses drained to sewers, 1,871.
Number of these houses not drained to sewers, 699.
Number of houses drained to sewers invaded by enteric fever, 58, or 3·1 per cent.
Number of houses not drained to sewers invaded by enteric fever, 18, or 2·6 per cent.

In 1898, it will be perceived, the proportion of drained houses invaded by enteric fever was but slightly in excess of the proportion of undrained houses so invaded. In 1897, however, the proportional incidence of the disease was materially heavier on drained than on undrained houses. It was, in fact, nearly twice as heavy on the former class, and in view of this circumstance, it is desirable to consider the relationship of the fever to drained and undrained houses in those particular neighbourhoods where it was most markedly prevalent in Chichester in 1897.

These neighbourhoods, as may be seen from the spot-map for that year (map B), were four in number, viz., Somerstown, Portfield, St. Pancras and the Hornet, and the vicinity of Orchard Street and Franklin Place. The number of dwellings invaded by the fever in 1897, and the condition of these dwellings as regards drainage, in each of those neighbourhoods, appear in the following table:—

TABLE IV.

SHOWING, for certain areas in CHICHESTER, the total number of Houses in each area (in 1898) together with the number in each instance, of these Houses, invaded by ENTERIC FEVER in 1897.

Neighbourhood.	Total Number of Houses in Neighbourhood (1898).	Number of Dwellings invaded by Enteric Fever.	Number of invaded Dwellings Drained.	Number of invaded Dwellings Undrained.
Somerstown ...	303	36	33	3
Portfield ...	335	26	9	17
St. Pancras and Hornet.	253	12	9	3
Orchard Street and Franklin Place.	180	10	7	3

It appears from this table that the bulk of the incidence of the fever on drained houses in 1897 was in Somerstown, where the number of fever-invaded houses that were drained was eleven times that of fever-invaded houses that were not drained. But it also appears from the table that in Portfield the main incidence of the fever, relative as well as actual, was not on drained houses, but on undrained houses. This contradictory result is not to be looked for if sewerage had been the main agency of fever distribution in 1897. It would, however, be consistent with the operation of some other agency which chanced to display much the same degree of activity in neighbourhoods in which there were unequal proportions of houses drained to sewers; thus bringing about a large number of invasions of drained houses in those districts where connection with the sewers had been generally made, but fewer invasions of drained houses where such connections were scantier. From this point of view the following table is instructive. It gives for each of the three years, 1896, 1897, and 1898, the number of houses connected with the sewers and the number of houses invaded by enteric fever in those years in each of the four neighbourhoods dealt with in Table IV., and also in that part of Chichester which lies within the old walls:—

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TABLE V.

SHOWING, for certain areas in CHICHESTER, the total number of houses in each in 1898; and the number of these houses connected with the SEWERS, as also of those invaded by ENTERIC FEVER, in each instance, in each of the three years 1896, 1897, 1898.

Neighbourhood.	Total No. of Houses (1898).	No. of Houses connected with Sewers, June 1, 1896.	No. of Houses invaded by Enteric Fever in 1896.	No. of Houses connected with Sewers, July 1, 1897.	No. of Houses invaded by Enteric Fever, in 1897.	No. of Houses connected with Sewers, June 1, 1898.	No. of Houses invaded by Enteric Fever, in 1898.
Within the old walls..	682	174	4	346	6	425	13
Somerstown...	303	127	18	251	36	285	8
Portfield ...	335	44	13	113	26	178	21
St. Pancras and the Hornet.	253	54	21	114	12	133	9
Orchard Street and Franklin Place.	180	65	11	139	10	154	10

Careful consideration of the figures in this table tends strongly to suggestion that during the three years 1896-8 there has been in Chichester some fever agency acting independently of the sewerage system. As regards that part of Chichester that lies *within the old walls* it will be observed that in 1896 and 1897 the amount of fever was small and practically the same, notwithstanding that in the meanwhile the number of houses within that area connected with the sewers had risen from 174 to 346. In 1898 there was some increase in the number of houses invaded by the fever in this neighbourhood; not, however, to extent sufficient to render this one of the areas especially affected by the disease in that year.* As regards *Somerstown*, it is noteworthy that while this district suffered heavily with the fever in 1896 and 1897, yet in 1898 it suffered hardly more in relation to its population than that part of Chichester that lies within the old walls. And yet, by 1898, nearly all the houses in Somerstown had become connected to the sewers; indeed, of the areas dealt with in the table, Somerstown, it will be observed, contains the largest proportion of drained houses. *Portfield*, on the other hand, is a neighbourhood that has been slow to avail itself of the sewerage system, nearly half of the houses in this area still remaining unconnected with sewers on June 1st, 1898. Yet Portfield has suffered considerably with the fever in each of the three years 1896-8; more especially in 1897, for which year the incidence of the disease on drained and undrained houses has already been given. *St. Pancras and the Hornet* is another district in which connection of houses with sewers has gone on slowly; at much the same rate, indeed, as in Portfield. Here, too, the fever incidence has been considerable; but remarkable in this, that it has declined in amount year by year from 1896 to 1898, notwithstanding that there was going on during these years material addition to the number of houses connected with the sewers. In the neighbourhood of *Orchard Street and Franklin Place* the amount of fever would seem to have remained stationary during the three years, 1896, 1897, and 1898; nevertheless during this period the number of houses connected with the sewers rose from 65 to 154, out of a total of 180 in this area.

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* It may be observed that of the 13 houses invaded in 1898 in this neighbourhood . four were among those in which the fever was locally referred to consumption of cockles.

The absence of parallelism between the behaviour of the fever in these several neighbourhoods and the sewerage conditions of the areas in question is, in our judgment, not consistent with those conditions having had material concern in dissemination of the disease. Nevertheless we deem it desirable to briefly consider views held in Chichester, by persons who maintain that the especial incidence of the fever on certain neighbourhoods is referable to these neighbourhoods being situate on the highest parts of the sewerage system. They contend that sewer air, pressing to the highest parts of the sewerage system, has found outlet there, and has, when charged with the infective material of enteric fever, brought about an outbreak of that disease in those localities where the highest parts of the sewerage system occur. It may very seriously be questioned whether in a system of sewers ventilated as are those of Chichester, sewer air would move in the manner claimed; but, however this may be, we have studied the levels of the sewerage system and of the ground in Chichester with a view to consideration of how far these levels favour behaviour of the sewer air in the manner suggested. As result we have ascertained the following facts concerning the several neighbourhoods dealt with in Table V.

Within the old walls.—In the northern half of this neighbourhood the levels of the sewer-inverts range from 38 to 42 ft. above Ordnance Datum, and the ground surface levels from 45 to 51·5 ft. above Ordnance Datum. In the southern half of this neighbourhood the levels of the sewer-inverts range from 32 to 38 ft., and the ground surface levels from 42 to 48·4 ft. above Ordnance Datum.

Somerstown.—The sewer-invert levels range from 36 to 42 ft., and the ground surface levels from 42·8 to 48·5 ft. above Ordnance Datum.

Portfield.—The sewer-invert levels range from 38 to 48 ft., and the ground surface levels from 48·3 to 53 ft. above Ordnance Datum.

St. Pancras and the Hornet.—The sewer-invert levels range from 37 to 43 ft., and the ground surface levels from 45·4 to 50·9 ft. above Ordnance Datum.

Orchard Street and Franklin Place.—The sewer-invert levels range from 28 to 37 ft., and the ground surface levels from 36·5 to 45·7 ft. above Ordnance Datum.

It appears from these data that in Portfield, where there has been considerable fever prevalence, the levels of sewer-inverts and of ground surface are decidedly higher than in the other neighbourhoods dealt with. But, on the other hand, Somerstown, which suffered so severely with the fever in 1896 and 1897, is on a part of the sewerage system which is no higher than that of the northern half of the area within the old walls, where there has been but little fever; while the ground surface levels of the northern half of the latter area are somewhat higher than those at Somerstown. The neighbourhood of Orchard Street and Franklin Place is, as regards levels of sewers and ground surface, the lowest of all the areas in Table V., and yet this is an area that suffered markedly from fever in 1896, 1897, and 1898. These facts are in direct contradiction to belief that the fever has displayed preference for those neighbourhoods that lie more highly, whether as regards levels of sewer-inverts or of ground surface. And we may cite, as further contradiction of such belief, the small amount of fever during 1896-8 from the upper parts of Broyle Road (north of Infirmary Terrace), where there is (exclusive of the barracks) a population of some 150 persons, and which is the highest part of Chichester, the sewer-invert levels reaching nearly 100 ft. above Ordnance Datum, and the ground surface reaching 105 ft. above Ordnance Datum.

There remains to be dealt with a further local suggestion in this connection; namely, that the sewerage system, while not acting as a direct fever agency, may have brought about the outbreaks of enteric fever in Chichester in 1896, 1897, and 1898, by causing, as result of the necessary excavations, disturbance of soil containing infective material. A hypothesis of this sort, be it observed, does not require a greater proportion of invaded houses among those drained than among those undrained, and to a corresponding extent is difficult either of support or of refutation. If, however, the disturbance of soil caused by laying trenches for sewers had the suggested relationship with fever prevalence, it is difficult to comprehend why outbreak of the disease did not come about sooner. For the sewerage works were commenced in September, 1893, at the sewage outfall works, whence trenching was carried on towards the town, which was reached in January, 1894; and trenching continued in the populous parts of Chichester during 1894 and early in 1895. Nevertheless, only one case of fever is known to have occurred in Chichester in 1894, and two in 1895. By the middle of 1896, when the fever assumed serious proportions, the sewerage system had been completed about a year.

Rainfall and Subsoil Water.

Rainfall.—Appended to this report will be found a record of the daily rainfall in the neighbourhood of Chichester during each of the three years 1896, 1897, and 1898, while the number of notified cases of enteric fever will appear, in weekly periods, from the annexed charts (Charts II., C., D., E.). On these charts are also shown the amounts of weekly rainfall in these years.

In 1896, after three widely separated cases earlier in the year, fever began to be seriously prevalent in Chichester towards the end of May, four cases being notified on May 24th-26th. (*See* Chart II. C.) These were followed by several more cases, notified on June 5th and days following. If, after infection, some eighteen days be allowed for incubation, diagnosis, and notification of the disease, time-relation between these cases in May and previous rainfall does not appear. For in May, 1896, there was no rainfall, save on the 20th-22nd, when 0·55 inch is recorded as having fallen. It may, however, be contended that time-relation existed between this rainfall and the series of cases in early June referred to, which were notified sixteen to eighteen days after its occurrence. Continuously heavy amount of fever in Chichester in 1896 did not set in until July 7th, and time-relation between this increased activity of fever and occurrence of rainfall during June is not indicated by the chart.

In 1897, after notification of four cases in April and May, fever began to manifest serious tendency to increase on June 12th, between which date and June 25th seven cases were notified. (*See* Chart II. D.) Continued prevalence of fever in serious amount ensued at the end of June and in early July. Time-relation, however, between these occurrences of fever and preceding rainfall does not appear in the chart; unless the period of incubation of the disease had been unusually short, in which case connection in the above sense may be claimed between these fever occurrences and the rainfall in the last week of May, and on June 17th-19th.

In 1898, after occurrence of a considerable number of scattered cases, fever became and continued seriously prevalent in the commencement of the second week of June. (*See* Chart II. E.) On May 19th and 20th, some twenty days prior to commencement of this continued prevalence of fever, there had fallen in the neighbourhood of Chichester 0·74 inch of rain. As regards the antecedent fever cases, these, it may be noted, commenced as early as January 3rd, and are known to have amounted, between that date and June 7th, to no fewer than twenty. Between these earlier cases and occurrence of rainfall no trustworthy time-relation can be traced.

These data as to occurrences of rainfall and of fever in Chichester in 1896, 1897, and 1898, are not, therefore, such as to support inference that in these years there has been sustained association of these conditions in the sense of cause and effect. The evidence, however, does not preclude possibility of there having been occasional relationship of the sort.

Subsoil water.—On Charts II., A., B., C., D., E., the weekly variations of level of subsoil water in Chichester are shown for the period June, 1894, to December, 1898. These variations are shown for weekly, not daily, periods, for the reason that the observations on which the chart is based had been made only once a week. The record, therefore, shown in diagrammatic form on the series of charts, is to be taken as showing, not all the oscillations of level of the subsoil water, but merely its general curve of rise and fall throughout the period dealt with. Comparison of this curve with the weekly occurrences of fever exhibited upon the chart shows that the outbreaks of enteric fever in 1896 and 1897 commenced in each instance when the level of the subsoil water was falling with some rapidity: but that in 1898 the serious prevalence of fever occurred at a time when the level of the subsoil water was indeed falling, though its fall was very slight.

As regards the actual level of the subsoil water at the times of occurrences of fever, 1898 differs materially from 1897 and 1896, as is seen in the series of charts. For, in 1898, when fever became seriously prevalent, the level of the subsoil water was not quite 28 ft. above Ordnance Datum, whereas, at the times of like occurrences in 1896 and 1897, it was 32 ft. and 32·5 ft., respectively, above Ordnance Datum. Furthermore, it is worthy of note that while there was in 1895 and 1896 considerable resemblance between the general lines of rise and fall of subsoil water, there were, in 1895, but two known cases of enteric fever in Chichester, whereas in 1896 there were 116 such cases. These data are not such as to encourage belief that there has been definite relation between the general rise and fall of subsoil water in Chichester and the occurrence of enteric fever there in 1896, 1897, and 1898.

In this connection it may be noted that there is some local belief in Chichester that enteric fever is apt to appear in this district when the subsoil water, after having submerged the sewers, falls again below their level. With a view to ascertaining if relation of this sort could be made out, the variations of level of subsoil water in the Portfield district, as recorded by weekly gaugings of a well there, have been considered in connection with sewer levels in that neighbourhood. The record in question extends from the latter part of June, 1894, to the end of May, 1898, and it shows that the subsoil water was above the level of the sewer invert on the following dates:—

November 26 and December 3; 1894.
January 7, 14, 21, 28; 1895.
February 4, 11, 18, 25; 1895.
January 25; 1897.
February 1, 8, 15, 22; 1897.
March 1, 8, 15, 22, 29; 1897.
April 5, 12, 19, 26; 1897.

It appears from this record that the Portfield sewers were submerged by the subsoil water in certain weeks in the end of 1894 and the beginning of 1895, the water falling below their level subsequent to February of the latter year. In 1895 two cases of enteric fever are known to have occurred in Chichester, one in September, the other in October; of these, the September case was in Portfield. So far as can be gathered from the weekly gaugings, the subsoil water had been three or four feet below the sewer-invert levels for some four months before this case occurred. In 1896, when thirteen houses in Portfield were invaded by enteric fever, the subsoil water is not recorded by these gaugings as having submerged the sewers in that neighbourhood at any time. In 1897 the Portfield sewers seem to have been submerged during February, March, and April; and in that year a case of fever occurred in Portfield on April 12, followed by two more in May. In later months several more cases occurred; twenty-six houses in all being invaded. In 1898, up to the end of May, when the record of weekly gaugings of the Portfield well ceases, the subsoil water is not recorded as having risen to within six feet of the sewer-inverts. Nevertheless in this year twenty-one houses in Portfield were invaded by enteric fever.

The subsoil water levels shown on the series of charts were obtained from gaugings of a well situated near the Chichester Cattle Market. This well was selected as being more centrally situated than any other in Chichester of which gaugings were available. Near this well the level of sewer-inverts is about 34 ft. above O.D., and there, as may be observed by reference to the series of charts, the subsoil water is recorded as having been above the level of sewer-inverts one week in January, 1895, and during most weeks of February and March, 1897, but not in either 1896 or 1898.

These facts do not afford support to the hypothesis that occurrence of enteric fever in Chichester has had relation with the submergence of sewers by the subsoil water.

The relations of subsoil water levels to ground surface levels also require brief reference. The well, from the gaugings of which the subsoil water levels shown in Charts II., A., B., C., D., E. were derived, is situated near Chichester Cattle Market, on the south-eastern border of the area described in this report as *within the line of the old walls*. The ground surface level at the mouth of the well is 45·48 ft. above Ordnance Datum. From consideration of the subsoil water levels shown on the series of charts, it accordingly appears that these levels ranged between 11 and 19 ft. below the ground surface level. Weekly gaugings of a well in the *Somerstown* neighbourhood indicated that there the subsoil water levels ranged between 3 and 11 ft. below the ground surface level. As, however, the record of gaugings from this well ceases in October, 1895, the lower limit of subsoil water level there is not strictly comparable with the lower limit indicated in the Cattle Market well; since the subsoil water levels in Chichester in 1897 and 1898 touched a lower point than in 1894, 1895, or 1896. Weekly gaugings of a well in *St. Pancras* indicated that the subsoil water levels ranged from 6 to 18 ft. below the level of the ground surface. Similar observations of a well in *Portfield* showed the subsoil water levels there as having ranged between 11 and 20 ft. below the ground surface level. The gaugings of a well in one of the areas in Chichester (*Whyke*) which has in recent years been characterized by comparative immunity from the fever, indicated that the levels of the subsoil water below the ground surface ranged from 8 to 16 ft. These comparative figures as to subsoil water levels in reference to the ground surface in different parts of Chichester do not appear to indicate relation between these conditions and fever prevalence.

OTHER FEVER AGENCIES.

From the foregoing facts and considerations it does not appear that sufficient explanation of the continued recurrence of serious prevalence of enteric fever in Chichester is to be found in relation with any of the fever agencies hitherto discussed.

Neither milk nor shellfish can be regarded as having been associated in any notable degree with the recurrent outbreaks of enteric fever in the district.

The evidence is not consistent with water having been a main factor in dissemination of the disease in recent years; while, as regards occurrences of fever in former years, the available data do not afford ground for definite conclusion on the subject.

For fever in those earlier years, the sewerage system, then not existent, cannot be held responsible, while the evidence furnished of regards recent outbreaks does not point to material concern, direct as indirect, of the sewerage system with these occurrences of fever.

Sustained relation between rainfall and fever prevalence is not suggested by the evidence, although there may have occurred from time to time direct association of one with the other.

The weekly records of the fluctuation in level of subsoil water do not indicate connection between these fluctuations and outbreaks of the fever, although it has to be borne in mind that more exact data such as would have been afforded by record of daily variations in the levels of subsoil water might have supplied indications not apparent in the weekly curves. Be this, however, as it may, indication of correlation between either rainfall or subsoil water fluctuations and occurrences of fever, would be but one step towards complete explanation of the frequently recurrent activity of the infective material of enteric fever in Chichester. The reason for the presence of this material in this district in the amount or in the quality sufficing for repeated manifestation of fever there, would still be to seek.

Of the known agencies of enteric fever other than those already discussed, but one remains for consideration: and to that one, or failing it, to some causative condition as yet unrecognised, we are driven by a process of exclusion. This agency, yet remaining for consideration, is soil. It may be that the conditions of the soil upon which Chichester, or some portions of Chichester, stand, are such as to foster in a higher degree than do those obtaining in most soils, the vitality and morbific power of the infective material of enteric fever. Present knowledge as to what may be the particular soil conditions favourable or unfavourable to this infective material is somewhat scanty. The researches of Dr. Sidney Martin and Dr. Robertson seem to indicate that soils rich in organic matter are more favourable to the vitality and growth of the bacillus of enteric fever than are soils in which there is little or no organic matter; and they afford also some information as to the influence of temperature, moisture, and the presence of other bacteria on the growth of this bacillus in soil. As regards the first of these conditions, that, namely, concerned with the presence of organic matter in the soil, there would seem to be good reason for belief that the ground on which the more populous parts of Chichester stand is fouled, and has long been fouled, to considerable extent in this way. For, in addition to the soakage of surface filth into the soil, usual in populous neighbourhoods, Chichester suffers from an additional source of soil pollution in the leaky cesspools and cesspit-privies which, until some three years ago, formed the sole methods of disposal of all its excrementitious matters; and which, even now, remain in the district in considerable amount. In so far, therefore, as the amount of organic matter in soil may reliably be gauged by the potential sources of pollution of that soil, Chichester may be regarded as presenting this condition more markedly than do many other town districts. It is, however, necessary not only to consider Chichester in this aspect as compared with other places, but also to compare several areas in the city, one with another, as regards degree of liability of the soil to fouling; and this because of the manner of distribution of fever in Chichester in recent and in former years, and also because of the periods of comparative quiescence of fever in this district, alluded to earlier in this report.

This comparison cannot, with our present means of knowledge, be made with accuracy. But consideration of the relative amount of poverty in several areas in Chichester may cast some light on this matter; since, as a rough guide to the amount of potential soil pollution in urban communities, it may be generally accepted that the poorer the neighbourhood the greater will these potentialities be. In Chichester, the poorest neighbourhood is St. Pancras, while Somerstown and Portfield are of somewhat better class. The area that lies within the old walls comprises, on the whole, fairly good class dwellings; with, however, the exception of one or two streets which are of no better quality than those in St. Pancras. The Orchard Street and Franklin Place area is, at the Orchard Street end, much like Portfield; while houses in the neighbourhood of Franklin Place are of better class. As regards fever prevalence in recent years, the areas in Chichester that have suffered most have been Somerstown, Portfield, St. Pancras and the Hornet, and Orchard Street and Franklin Place; while within the old walls there has been but little fever. The four first-mentioned areas have been set down in the order which, as regards proportional amount of fever, they suffered; there is, however, but little difference in this respect between one and another of these areas. In the main, therefore, the distribution of fever in Chichester in recent years would seem to have been such that the poorer neighbourhoods, in which fouling of the soil is likely to be greater than elsewhere, suffered most heavily. But it is noteworthy that, as regards fever in Chichester in earlier years, a like distribution is not observable during the period 1870-84. During this period the area that lies within the line of the old walls suffered with fever in nearly the same proportion as the rest of the district, and this, notwithstanding that at that time the character of the population in each of the several areas under consideration would seem to have been much the same as in recent years. Nor does the fever seem to have exhibited preference, during this period, for the poorest neighbourhoods in the area within the line of the old walls.

Indication as to the degree of potential soil pollution in these areas may also be hoped for from consideration of the methods of excrement disposal in them: and, accordingly a statement of the proportion of houses in each area still draining to cesspools or served by cesspit-privies, at the end of 1898, here follows:—

—	Proportion of Houses Draining to Cesspools.	Proportion of Houses with Cesspit Privies.
	Per cent.	Per cent.
Within the Old Walls	4·8	22
Somerstown	0·3	4·3
Portfield	3	14
St. Pancras and the Hornet	none	23
Orchard Street and Franklin Place ...	none	6

It appears, therefore, that at the end of 1898, the area within the old city walls had somewhat the largest proportion of houses either drained to cesspools or served by cesspit-privies, while St. Pancras and Portfield came next in this respect. Obviously, however, this state of matters at the end of 1898, in a town such as Chichester, with a recently introduced sewerage system, cannot be taken as a guide to what existed even a few years ago. Prior to the introduction of the sewerage system in 1895, houses were served either by water-closets drained to cesspools which would seem to have allowed most part of their contents to escape into the surrounding soil, or by cesspit-privies, also of leaky sort. By which of these two methods of excrement disposal the greater amount of soil pollution would be brought about is difficult to say; nevertheless, the degree to which one or other method formerly obtained in the several neighbourhoods under consideration, may here be stated. From information furnished on this subject it would seem that, prior to the introduction of the sewerage system in Chichester, houses in the area within the line of the old walls either drained to cesspools or had cesspit-privies, with, however, a majority of the former class. Somerstown, Portfield, St. Pancras, Orchard Street and Franklin Place, were almost entirely cesspit-privy districts. The Hornet, however (comprised in the area of St. Pancras and the Hornet), had about as many houses furnished with water-closets draining to cesspools as with cesspit-privies. It appears, therefore, that in recent years the fever has, in the main, chiefly affected those of the areas under consideration that may be termed cesspit-privy neighbourhoods, appearing in less degree in the area within the walls where cesspools, as well as cesspit-privies, abounded. But this apparent preference of the fever for cesspit-privy neighbourhoods does not extend to those parts of Chichester not included in the several areas selected for special consideration. Those other parts, which were mainly cesspit privy neighbourhoods, have had but little fever in recent years. An illustration of this is afforded by the neighbourhood of *Whyke;* an area with some 420 houses, lying to the south-east of the central portion of Chichester. This area was formerly served almost entirely by cesspit-privies. Nevertheless in the three years 1896-7-8, but 15 houses in Whyke are known to have been invaded by the fever. It has also to be borne in mind that during the earlier period 1870-84, cesspool and cesspit-privy neighbourhoods seem to have suffered from fatal fever in much the same degree.

These considerations as to the degree of potential soil pollution in Chichester, and in several particular areas in Chichester, regarded in relation with the varying preference of enteric fever now for one and now for another area, together with occasional periods of comparative immunity of the whole district from this disease, do not favour belief that these potentialities as to soil pollution are in themselves sufficient explanation of the long continuance of this fever in serious amount in Chichester. And, indeed, although these potentialities have been and still are, in Chichester, greater than they should be, and although they are greater than in many other urban communities, yet it is difficult of belief that there are not still other towns in this country where these potentialities are as great as in Chichester, but where, nevertheless, fever has not prevailed to so serious an extent. Further knowledge, therefore, would seem necessary for discovery of the causation of the serious prevalence of enteric fever in Chichester. Thus, it does not necessarily ensue that two soils subject to the same degree of potential pollution, do, in effect, become and continue equally polluted. It may well be, and is, indeed, even to be anticipated, that polluting matters disappear more readily from some soils than from others; so that the latter, even when subject to the same degree of pollution, nevertheless are in a habitually fouler condition than the former. But how this may be in Chichester we know not. It is known that for the most part Chichester stands on surface mould and gravel overlying the London and Reading Beds; but it is not known what is the thickness of this sheet of gravel save at one or two points, nor what, if any, variation there may be in the

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character of this gravel. There is like want of knowledge as to variations in quantity and quality of the surface mould covering the gravel. Nor is it known what may be the influence, as compared with that exercised by other soils, of such a soil as that underlying Chichester upon organic matter reaching it, in the way of bringing about conditions more or less favourable to the viability and morbific power of the infective material of enteric fever.

The above, however, constitute but a small part of the total conditions appertaining to soil, regarding which there is no adequate knowledge, but which may count for much in determining its suitability or otherwise as a medium for the life and growth of the enteric fever bacillus. Thus there is some knowledge, as already stated, concerning the degree of moisture of soil and the degree of soil temperature best adapted to this organism; but as to the qualities of Chichester soil in these respects no information is available. Again, the relations between the enteric fever bacillus and other micro-organisms in soil may conceivably have important bearing on the life and activity of the former. Some soils may contain organisms obnoxious to the enteric fever bacillus, others may contain organisms that encourage the growth or intensify the virulence of that bacillus. Yet of this aspect of the matter all but nothing is known. *

In our judgment, hypothesis that the prevalence of enteric fever in serious amount in Chichester is referable to the existence there of soil conditions especially favourable to the viability and growth of the infective material of this disease, is not inconsistent with the facts ascertained by us and set out by us in this report. But, on the other hand, such hypothesis, while not inconsistent with these facts, does not at present afford adequate explanation of features that have characterised the fever in its distribution in time and place in Chichester. Fuller knowledge of soil conditions in their relations with fever prevalence may account for these features; without that knowledge it is not possible to arrive at definite conclusion.

The likelihood of acquiring such knowledge would be materially enhanced by widening the scope of inquiry directed to this end. Investigation, in this connection, of the circumstances of certain places other than Chichester, may be looked to as not unlikely to afford helpful information on this subject. As instance, careful comparison of the similarities and dissimilarities in local conditions obtaining in places exceptionally prone to enteric fever with those obtaining in places that suffer but little from enteric fever, would seem to be indicated. Such investigations would need to be supplemented by skilled research on the part of the statistician, the geologist, the chemist, and the bacteriologist, and would entail prolonged and arduous labour in all their aspects. They are, nevertheless, in our judgment, urgently called for in the interests not only of Chichester but also of not a few other localities in this country where enteric fever is endemically prevalent in such amount as to take, year after year, a toll of deaths greatly in excess of the proportion claimed by this disease in England and Wales as a whole.

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* Account of interesting researches on this subject by Dr. Sidney Martin will be found in Appendix B, No. 5, of this Volume.

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On Enteric Fever in Chichester; by Dr. Thomson and Colonel Marsh.

POSTSCRIPT ON ENTERIC FEVER IN CHICHESTER IN 1899; BY DR. THEODORE THOMSON.

THE year 1899 has been, like the three years immediately preceding it, marked by recurrence of enteric fever in Chichester in notable amount. By the end of September, 76 cases of this disease had been notified to the local authority as having occurred within their district—exclusive of cases imported into public institutions in Chichester from other districts. Six of these cases occurred during March and April; the remainder as shown in the following weekly periods.

During	the	week	ending May	6	3
„	„	„	„	13	4
„	„	„	„	20	7
„	„	„	„	27	4
„	„	„	June	3	11
„	„	„	„	10	7
„	„	„	„	17	7
„	„	„	„	24	6
„	„	„	July	1	1
„	„	„	„	8	1
„	„	„	„	15	2
„	„	„	„	22	7
„	„	„	„	29	1
„	„	„	August	5	1
„	„	„	„	12	1
„	„	„	„	19	–
„	„	„	„	26	–
„	„	„	September	2	2
„	„	„	„	9	2
„	„	„	„	16	3
„	„	„	„	23	–
„	„	„	„	30	–

The majority of the cases, it will be seen, occurred during the months of May and June.

During these nine months of 1899, eleven deaths were referred to enteric fever in Chichester: a fatality rate of 14·5 per cent.

The most noteworthy feature of the fever of 1899 has concern with its distribution in place; which was remarkable in this, that the comparative immunity of the area within the line of the old walls from the disease, noted as having obtained in recent years, is no longer evident.*

The following short tabular statement indicates the incidence of the fever of 1899 on houses in the whole of Chichester, as well as in certain areas, already specially referred to in the foregoing Report.

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* It is noteworthy that the incidence of fever in 1899 has been greater in the north-western quarter of the area *within the line of the old walls* than on other portions of this area. Also that the fever, in this year, exhibited marked preference for the poorer neighbourhoods in this area.

SHOWING for the whole of CHICHESTER, and for each of certain areas in CHICHESTER, the total number of houses and the number of such houses known to have been invaded by ENTERIC FEVER during the nine months January to September, 1899.

Area.	Total Number of Houses.	Number of Houses known to have been invaded by Enteric Fever, January to September, 1899.
Within the Old Walls	682	16
Somerstown	303	6
Portfield	335	6
St. Pancras and the Hornet ...	253	13
Orchard Street and Franklin Place	...	5
Other Areas	827	12
The whole of Chichester	2,580	58

It will be seen from the above table that the area within the old walls not only suffered proportionally as much from the fever as the whole of Chichester; but also relatively more than some of the other areas for which the disease has in recent years manifested a marked preference. The area which continues to show a comparatively high incidence of the fever is St. Pancras; which is, it will be remembered, the poorest neighbourhood in Chichester. It may be noted that in the neighbourhood of Whyke, an area referred to in the body of the Report, only 5 houses out of a total of some 420 houses in that area, were invaded by the fever in 1899.

Of the total number of houses in Chichester, 1,971 were receiving the public water supply on May 1st, 1899; while 609 derived their water from private wells. Of the former class of house 41, or 2·1 per cent., were invaded by the fever; of the latter class 17, or 2·8 per cent. were invaded. There was, therefore, a somewhat greater incidence of the disease on houses deriving their water from private wells than on houses supplied from the public service.

The number of houses in Chichester drained to sewers on May 1st, 1899, was 2,133: the number of houses not so drained was 447. Of houses drained to sewers, 49, or 2·3 per cent., were invaded by the fever; while of houses not so drained, 9, or 2 per cent., were invaded. The relative incidence of the disease, therefore, on these two classes of houses was almost the same.

Investigation failed to reveal relation of causative sort between milk supply and the fever.

During May and June, when the fever prevalence was at its height in Chichester, there was considerable suspicion locally that the consumption of cockles, infected with the specific contagium of enteric fever, was responsible for the occurrence of no small number of cases of the disease. As result of careful inquiry it appeared probable that certain persons had actually contracted the fever in this way. Investigations on this subject were made locally in late July and early August, by which time nearly 70 cases of enteric fever had been

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reported to the local authority. As regards these cases it appeared that in 20 instances cockles had been partaken of within a month of the onset of illness: the remainder of the persons attacked by the fever had not partaken of cockles within that period. Of the 20 referred to, 18 had eaten of cockles within 3 weeks of attack. In some instances, however, this relation in time between consumption of cockles and occurrences of the fever constituted the only apparent ground for attributing the latter to the former. But, as regards 13 of these 20 persons, probability of causal connection was indicated by other evidence; such as nearly simultaneous onset of symptoms of the fever in two or more persons who had partaken together of cockles some ten or fourteen days previously; or the occurrence, within 24 hours of consumption of cockles by several persons, of sickness, followed, a week or two later, by development of enteric fever in one or more of the consumers. In most instances it proved impossible to ascertain whence the cockles had been derived: but, as noted in the body of the Report, many cockles known to be obtained from mud-flats liable to pollution by sewage, are sold in Chichester. The share of the fever, however, which can reasonably be referred to consumption of cockles, is but small. The 13 cases referred to occurred in 4 houses: the remaining 7 cases, regarding which evidence of causal connection between the fever and consumption of cockles is less trustworthy, involved other 4 houses.

ADDENDUM A.

DRINKING-WATER.

Memorandum No. 3.—Previous Sewage or Animal Contamination.

THERE is reason to believe that the excrementitious matters which exist in sewage are often possessed of intensely infectious properties; and that sewage mixing with water, even in the minutest proportion, is likely, by such properties, to spread particular diseases among populations which drink the water.

Thus is explained the peculiar power which impure waters have been shown to exercise on many occasions, in promoting great epidemics of typhoid fever and cholera.

The existence of an infectious property in water cannot be proved by chemical analysis, and is only learnt, too late, from the effects which the water produces on man. But though chemistry cannot prove any existing infectious property, it can prove, if existing, certain degrees of sewage-contamination. And every sewage-contamination which chemistry can trace ought, *prima facie*, to be held to include the possibility of infectious properties.

Nearly the whole of the animal matter which gains access to drinking-water consists of sewage, that is,—solid and liquid excrement.

The column headed "Previous Sewage or Animal Contamination," in the accompanying analytical table, expresses in terms of average London sewage, the amount of animal matter with which 100,000 lbs. of each water was, at one time or other, contaminated. Thus 100,000 lbs. of the water of Well B. at Chichester had been polluted with an amount of animal matter equal to that contained in 18,958 lbs. of average London sewage. So far as chemical analysis can show, nearly the whole of this animal matter had been oxidized and converted into mineral and innocuous compounds at the time the analysis was made: there is, however, always a risk lest some portion (not detectable by chemical or microscopical analysis) of the noxious constituents of the original animal matters should have escaped that decomposition which has resolved the remainder into innocuous mineral compounds. But this evidence of previous contamination implies much more risk, when it occurs in water from rivers and shallow wells, than when it is met with in the water of deep wells, or of deep-seated springs. In the case of river water there is great probability that the morbific matter sometimes present in animal excreta will be carried rapidly down the stream, escape decomposition, and produce disease in those persons who drink the water; as the organic matter of sewage undergoes decomposition very slowly when it is present in running water. In the case of shallow-well-water, also, the decomposition and oxidation of the organic matter are liable to be incomplete during the rapid passage of polluted surface water into shallow wells. In the case of deep-well and spring water, however, if the proportion of previous contamination do not exceed 10,000 parts in 100,000 parts of water, this risk is very inconsiderable, and may be regarded as *nil* if the direct access of water from the upper strata be rigidly excluded; because the excessive filtration to which such water has been subjected in passing downwards through so great a thickness of soil or rock, and the rapid oxidation of the organic matters contained in water when the latter percolates through a porous and aerated soil, afford a considerable guarantee that all noxious constituents have been removed.

It follows from what has been already stated that chemical analysis cannot discover the noxious ingredient or ingredients in water polluted by infected sewage or animal excreta; and as it cannot thus distinguish between infected and non-infected sewage, the only perfectly safe course is to avoid altogether the use, for domestic purposes, of water which has been polluted with excrementitious matters.

This is the more to be desired because there is no practical process known, whereby water, once contaminated by infected sewage, can be so purified as to render its domestic use entirely free from risk.

Nevertheless, as it is very difficult in some localities to obtain water which has not been more or less polluted by excrementitious matters, it is desirable to divide such previous contaminated drinking waters into three classes, viz.:—

1. Reasonably safe water.
2. Suspicious or doubtful water.
3. Dangerous water.

Reasonably Safe Water.—Water, although it exhibits previous sewage or animal contamination, may be regarded as reasonably safe when it is derived either from deep wells (say 100 feet deep), or from deep-seated springs; provided that surface-water be carefully excluded from the well or spring, and that the proportion of previous contamination do not exceed 10,000 parts in 100,000 parts of water.

Suspicious or doubtful water is, 1st, shallow-well, river, or flowing water which exhibits any proportion, however small, of previous sewage or animal contamination; and, 2nd, deep-well or spring water containing from 10,000 to 20,000 parts of previous contamination in 100,000 parts of water.

App. A, No. 7.
On Enteric Fever in Chichester; by Dr. Thomson and Colonel Marsh.

Dangerous water is, 1st, shallow-well, river, or flowing water which exhibits more than 20,000 parts of previous animal contamination, is 100,000; 2nd, shallow-well, river, or flowing water containing less than 20,000 part of previous contamination in 100,000 parts, but which is known from an actual inspection of the well, river, or stream, to receive sewage, either discharged into it directly, or mingling with it as surface drainage. 3rd. As the risk attending the use of all previously contaminated water increases in direct proportion to the amount of such contamination, deep-well or deep-seated spring water exhibiting more than 20,000 parts of previous contamination in100,000 must be regarded as dangerous. River or running water should only be placed in the second-class provisionally, pending an inspection of the banks of the river and tributaries; which inspection will obviously transfer it either to the class of reasonably safe water if the previous contamination be derived exclusively from spring water, or to the class of dangerous water if any part of the previous contamination be traced to the direct admission of sewage or excrementitious matters.

E. Frankland,
Analytical Laboratory,
The Yews,
Reigate, Surrey.

Water-Analysis Laboratory,
The Yews, Reigate,
November 19, 1898.

Sir,

Herewith I enclose results of analysis of the two samples of shallow well water which you sent here for examination from Chichester.

Both these waters contain only a small proportion of organic matter, but they are derived from very impure sources, and the organic matter is of animal origin. Well B. is the worst. Nearly one-fifth of the water of this well has been in the condition of average London sewage.

The water of both wells is dangerous to health, and therefore unfit for domestic use. Both wells ought to be closed.

I am, Sir,
Your obedient servant,
E. Frankland.

Col. J. T. Marsh, R.E.

RESULTS OF ANALYSIS EXPRESSED IN PARTS PER 100,000.
Collected by Col. Marsh, 12th November, 1898.

Number of Sample.	Description.	Total solid Matters.	Organic Carbon.	Organic Nitrogen.	Ammonia.	Nitrogen as Nitrates and Nitrites.	Total Combined Nitrogen.	Previous Sewage or Animal Contamination.	Chlorine.	Hardness.			Remarks.
										Temporary.	Permanent.	Total.	
11,023	A. Well in Chichester.	33·12	·032	·008	0	·728	·736	7,248	2·4	18·3	5·3	23·6	Turbid.
11,024	B. Do. do.	52.80	·065	·012	0	1·887	1·899	18,958	4·6	28·8	5·6	34·4	Slightly turbid.

E. Frankland,
The Yews,
Reigate.

App. A, No. 7.

On Enteric Fever in Chichester; by Dr. Thomson and Colonel Marsh.

ADDENDUM B.

Rainfall for 1896; in Inches.

Recorded at Chichester Sewage Works.

Date.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	·04	...	·05	...	...	...	...	...	·71	...	·02	·15
2	...	...	·05	...	...	...	·13	...	·44	...	·02	·66
3	...	...	·21	...	...	...	·04	...	·34	·20	...	·23
4	...	...	·26	...	...	·29	...	...	·92	·07	...	·80
5	...	·02	...	...	...	...	...	...	·06	·31	...	·32
6	...	...	·03	...	..	...	...	...	...	·76	...	·18
7	...	...	·16	...	...	·26	...	...	...	·14	·25	...
8	...	·05	·16	...	...	·10	...	·04	·38	·10	·05	·16
9	...	...	·01	...	...	...	...	·07	·02	·03	...	...
10	...	...	...	...	...	1·40	...	...	·72	...	...	·12
11	...	...	·08	·02	...	...	...	...	·31	...	...	·06
12	·05	·02	·08	·05	...	...	...	...	·95	·15	...	·17
13	·10	...	...	·08	...	...	...	...	·28	·06	·04	·81
14	·05	...	...	·15	...	...	...	...	·01	·08	·32	·01
15	·01	...	·06	...	...	...	...	...	·25	·03	·18	...
16	...	...	·03	·06	...	...	·02	...	...	·33	...	...
17	...	...	·20	...	...	·11	...	...	·36	·10	...	...
18	·03	...	·22	·03	...	...	...	·11	·05	·30	·05	...
19	...	·05	...	...	...	...	...	·05	..	·09	·06	...
20	·02	·37	1·06	...	·11	...	...	...	...	...	...	...
21	...	·04	·02	..	·32	...	...	...	·42	...	...	...
22	·02	...	...	...	·12	...	...	...	·35	...	...	...
23	...	...	...	...	...	...	...	...	...	...	...	...
24	·15	...	...	...	...	·03	...	·20	·84	·19	...	·28
25	·40	...	...	...	...	...	...	·34	·03	·10	...	·02
26	...	...	·15	...	...	...	·80	·05	·20	·31	...	·05
27	·13	·03	...	...	...	...	...	...	·09	...	...	·09
28	...	...	1·23	...	...	...	...	...	·02	...	...	·09
29	...	·03	·08	...	...	...	·16	...	·11	·03	...	·06
30	...		...	...	...	...	·04	·38	...	...	...	·06
31	...		...		...		·11	·22		...		·09
	1·00	·61	4·14	·39	·55	2·19	1·33	1·46	7·86	3·40	·99	4·41

E. L. Shera.

App. A, No. 7.

On Enteric Fever in Chichester; by Dr. Thomson and Colonel Marsh.

RAINFALL FOR 1897; IN INCHES.

Recorded at Chichester Sewage Works.

Date.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	...	·74	·71	·07	...	·08	...	...	·45	...	...	...
2	...	·40	·60	·11	·04	·02	...	...	·16	·14	...	...
3	...	·05	...	·16	...	...	...	...	·03	...	...	...
4	·11	·90	·06	...	·12	·06	...	...	·30	...	...	...
5	·10	·15	...	..	·05	...	·06	...	·50	...	...	·08
6	·28	·05	...	·21	·01	...	·01	...	·02	...	...	·10
7	·45	...	...	·02	...	...	...	...	...	...	·38	·52
8	·72	·15	...	...	...	·71	...	·45	·20	...	·05	·06
9	·03	·02	·25	·05	...	·92	...	...	·06	...	...	...
10	·18	·32	·03	...	·02	...	...	...	...	...	...	·40
11	...	·10	·45	·02	...	...	...	...	...	...	·01	·30
12	...	...	·05	·09	...	...	...	...	...	...	...	·25
13	·02	·05	...	·02	...	...	...	·02	...	·11	...	·14
14	...	...	·51	...	...	...	...	...	...	·03	·36	·18
15	...	...	·18	·19	...	...	...	...	...	·08	...	·02
16	...	...	·22	·25	...	...	...	...	·15	...	·05	...
17	...	...	·25	·20	...	·16	...	·08	·42	...	...	...
18	...	·02	·07	...	...	·05	...	·06	...	·03	...	...
19	·13	·16	...	·19	...	·28	·03	·11	·07	·01	...	...
20	...	·07	...	·03	...	...	...	·12	...	...	...	...
21	·04	...	·07	·09	...	...	·52	·02	...	...	...	...
22	·03	...	...	...	...	...	...	...	·09	...	...	...
23	...	...	...	...	...	...	...	·01	·02	...	...	...
24	...	...	...	...	...	...	...	·26	·02	...	·13	...
25	...	...	...	...	...	...	...	·17	·02	·12	...	...
26	...	...	...	...	·07	·62	...	·28	...	...	·03	...
27	...	...	...	...	·07	...	...	...	·25	...	·45	·25
28	...	·14	·07	...	·06	·45	...	·03	...	...	·07	·17
29	·14		...	...	·20	...	...	·07	·12	...	·03	·20
30	·06		...	·15	·27	...	...	·36	...	...	·42	·08
31	·44		·40		·23		...	·32		...		·30
	2·73	3·21	3·92	1·85	1·14	3·35	·62	2·36	2·88	·52	1·98	3·06

E. L. SHERA.

RAINFALL FOR 1898; IN INCHES.

Recorded at Chichester Sewage Works.

Date.	Jan.	Feb.	Mar.	April.	May	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	·16	·07	·11	...	·20	·03	·10	...	...	...	·13	...
2	...	...	...	...	·02	...	...	...	...	...	·27	...
3	·01	·06	·17	...	·42	...	...	·07	...	..	·10	...
4	...	·05	...	...	·02	...	...	...	...	...	...	...
5	·37	·21	·04	...	·46	...	...	·01	...	...	·07	...
6	·10	·01	...	...	...	·45	...	·05	...	...	...	...
7	...	...	...	...	...	...	...	·60	...	...	...	...
8	...	...	...	...	·09	·52	...	..	...	...	...	...
9	·01	...	...	...	...	...	...	·04	...	·05	...	...
10	...	...	...	·10	·22	...	...	..	...	...	...	...
11	...	...	...	·06	·18	...	...	...	...	...	...	...
12	...	...	...	...	...	...	...	...	...	...	·10	...
13	...	·07	...	·04	·53	...	·04	...	·01	...	...	...
14	...	...	·06	·15	·26	...	...	...	...	·20	...	...
15	...	...	·03	...	...	...	...	...	..	·15	·03	...
16	...	...	...	...	...	...	...	...	...	·40	...	...
17	...	·16	...	...	...	...	...	...	...	·59	...	...
18	...	·25	...	...	...	·02	...	·33	·14	·30	...	...
19	...	...	·03	...	·18	...	·01	...	...	·25	...	...
20	·03	·07	...	...	·56	...	...	...	...	·42	·30	...
21	...	·60	...	...	...	...	...	...	...	·02	·55	...
22	...	...	...	...	·07	...	·18	...	...	·08	·42	...
23	...	...	...	...	...	...	...	...	...	...	1·05	...
24	...	...	...	...	...	·18	...	...	...	·20	·30	...
25	...	·06	·11	...	·07	..	...	...	...	...	·18	...
26	...	...	·05	·14	...	·45	...	...	...	...	...	..
27	.	·05	...	·21	...	·08	·32	·18	·07	...	·03	...
28	...	·01	...	·11	...	...	·05	·04	...	...	...	...
29	·02		...	·11	·01	·05	...	·09	·85	·53	...	...
30	...		·08	·12	·01	...	...	...	...	·50	...	...
31	...		...		·09		...	...		·02		...
	·70	1·67	·68	1·04	3·39	1·79	·70	1·14	1·07	3·71	3·53	...

E. L. Shera.

ADDENDUM C.

EXTRACTS from Dr. BULSTRODE'S REPORT to the LOCAL GOVERNMENT BOARD upon PREVALENCE of ENTERIC FEVER in the CITY of CHICHESTER.

The chief industries of the district are those connected with agriculture, brewing and tanning. The city is the market town of the surrounding districts; a cattle market, the largest in the south of England, is held here fortnightly, and the Cathedral attracts numerous visitors.

The main streets of the city, which are wide and well-constructed, run directly north, south, east, and west, and in the centre of the city stands the old market cross. The town is traversed by the Lavant and by branches of this river, some of them artificial. In winter the river and its branches give passage to a good deal of upland water, but in summer all these channels tend to become dry or to contain more or less elongated pools of stagnant water.

In former times the Lavant received much slop-water and not a little sewage, but these sources of pollution are now far fewer than formerly; drains are being rapidly cut off from the river, and made to discharge into the recently constructed sewer system. There were, however, at the time of my visit, sundry privies, the contents of which oozed through the bank into the channel at St. Pancras, and slop-water was here and there being cast into the bed of the stream. This state of affairs was exceptionally well marked behind some cottages, Nos. 90-94, in St. Pancras, the inmates of all of which got rid of their slop-water into the channel, and obtained their drinking water from a well hard by; on the opposite bank was an offensive privy used by the tenants of the cottages referred to. In addition to sundry sources of pollution in St. Pancras, slop-water enters the channel at intervals at other parts, and at one place, near Southgate, a house drain discharges into it. In Orchard Street there are also sundry sources of pollution. The culvert running from near Eastgate to just beyond Southgate is brick-bottomed, and by this means is kept clearer from deposit than would otherwise be the case; but beneath Orchard Street and thereabouts, where the bed of the river is unbricked and irregular, there is a thick deposit in its bed of offensive matter.

As a general rule, there is in Chichester but little overcrowding of houses upon area; usually a curtilage of some size is attached to each house or group of houses. There are, however, exceptions to this rule; notably, in some of the poorer parts of St. Pancras, where some few houses have practically no curtilage whatever, while others abut upon the Lavant, and, as has been said, dispose of their slop-water and other refuse in the river. In spite, however, of the fact that houses, even of the poorer sort, are generally provided with curtilage, it can rarely happen, that sufficient space obtains to safely allow of excrement and slop-water being deposited into one or more holes in the pervious soil, and of pure water being obtained from another. In certain of the premis which I visited the condition of the yards was extremely unwholesome; and although in some cases the houses had recently been drained, the work had been now and again done in such a careless manner that the present state of the yard surface was probably no better than before. It may, too, be remarked in regard of several houses that I visited, and which had been recently drained, that the privy vaults had, together with their contents, perhaps the accumulation of some years, been simply filled in, and not, as they should have been, carefully emptied, their bricks removed, and their sites carefully cleansed. In one case which was brought prominently to my notice, and where enteric fever was prevailing, the buried privy contents still at times made themselves manifest on the adjoining wall; and in other instances complaints of a somewhat similar nature were heard of.

The Water Supply of Chichester.

The city of Chichester is supplied with water partly by private wells, partly by the Chichester Waterworks Company. The wells are of that kind known as "shallow"; *i.e.*, they are not sunk through any impermeable stratum, but consist of excavations sunk in the gravel overlying clay. These wells are dry-steined, and thus are but imperfectly protected against filth soaking through the soil. In the majority of instances the water is raised from these wells by means of pumps; but in some cases, especially in that part of the town which is rural in character, water is often raised by means of a windlass, and wells are covered over with wooden lids, which frequently are not so fitted as to protect them from the influx of surface water. The position of these wells was, in the great majority of cases which I inspected, a dangerous one. Frequently wells were found but a little distance removed from non-watertight privies and cesspools, to which reference will shortly be made; and it was obvious that the water contained in them was in danger of becoming fouled by infiltration of cesspool or privy contents. In numerous instances the exact position of the well was a matter of surmise only, the present tenant of the dwelling having had no occasion to ascertain its whereabouts. A large number of these shallow wells in Chichester have been made to furnish water for chemical examination, and many have been pronounced highly polluted. It is clear, however, whatever may be the finding of the chemist or of the bacteriologist as regards any given sample, that a very large number of the Chichester wells are in very dangerous positions.

The Chichester Waterworks Company obtain their supply from a well which was constructed in 1874, and which is situated on the Portsmouth Road at a point distant some 1½ miles west of the centre of the city. The well has a total depth of 47 feet from the floor of the engine house, the first 17 feet being lined with 9-inch brickwork, the remaining 30 feet with wrought iron cylinders. In reference to the geological strata through which the well is sunk, it may be recorded that after passing through the superficial soil and gravel, the combined thickness of which, I am informed by Mr. Shelford, the Engineer, is but a few inches, a stiff clay was encountered which continued to a depth of 23½ feet. At this point chalk marl was reached, and after penetrating this for some 2½ feet, water entered the well in large quantities. The remainder of the well shaft penetrates chalk marl and chalk.

The water is raised by means of two engines, each capable of throwing 10,000 gallons per hour; but the total maximum average yield of the present well is, it appears, not more than some 15,000 gallons per hour. By working both engines at full speed the water may be quickly reduced to its lowest point, *i.e.*, 29 feet below the engine floor. If the engines are now stopped the well will fill up to the level of the overflow in 23 minutes, and to within 10 feet 6 inches of the floor in 12 minutes. At the present time the consumption of water in the city necessitates constant pumping, and it is contemplated, therefore, that additional borings for water will shortly be necessary. The water is pumped up into a main passing through Chichester, which it supplies on its way to reservoirs situated on the north of the city. One of these reservoirs is at the ground level, the other some 40 feet higher. The storage capacity is at present 200,000 gallons, each of the above-mentioned reservoirs holding some 100,000 gallons. The higher reservoir is for the supply of the barracks and all parts of the town that are situated above the level of the Infirmary.

The draft on the ground level reservoir (capacity 100,000 gallons), when no water is being pumped into it, is found to be about 8,000 gallons per hour, so that the capacity of the reservoir is only about 12 hours supply.

The water from this well has been analysed on several occasions. On March 10th, 1879, Dr. J. Muter, F.C.S., pronounced the water to be "a water of very excellent quality indeed."

In April, 1893, Dr. Frankland reported that "the water possesses "a very high degree of organic purity, and it is in every way well fitted "for dietetic use. It is of most excellent quality. It is slightly "harder than Thames water, but will soften down to less than two "degrees of hardness upon Clarke's scale, or 2·6 per 100,000."

Excrement and Refuse Disposal.

Excrement is disposed of partly by means of a recently constructed sewer system, partly by means of privy cesspits and cesspools. Use in the above sense of the public sewer system is an increasing one.

The privy cesspits are capacious receptacles situated in the curtilages of the houses; they are lined mostly with brick, but not in such a manner as to render them watertight. Over the cesspits are erected commonplace privy structures, and, in numerous instances which I saw, these edifices were much dilapidated, while their floors which covered part of the pits were, not unfrequently, found unsafe. The cesspits in a very large number of instances are in situations which must be regarded as unduly near the houses which they serve. They, too, are often within a few feet of the well from which the drinking water of households is derived, in circumstances which cannot fail to seriously endanger the wholesomeness of the well water. Even where the cesspits have been done away with, and the houses connected with the sewers, I found, as I have said, that, in not a few instances, the cesspit had been simply filled up, and not, as it should have been, carefully dug out and cleansed. The cesspools are, like the privy pits, not watertight; they are, as a rule, covered over in such a manner as to conceal their whereabouts, and in many cases the occupier had only a very vague notion as to the locality of his cesspool. In only a few instances are they properly disconnected from drains, and some of them appear to ventilate directly into the sculleries or kitchens of the houses. Everywhere cesspits and cesspools are numerous; in fact, it would seem that the whole of the gravel upon which Chichester is built is riddled with them. Some that had not been covered over and forgotten were brought to light during recent operations connected with the drainage. The emptying of the cesspools and cesspits is left to occupiers, who exercise their own discretion in the matter. As regards some of the premises which I visited, the dates, or even the fact, of the last emptying of the cesspool could not be called to mind. It is certain, too, from the infrequency with which cesspools require to be emptied, that the greatest part of their fluid contents must find its way into the gravel underlying Chicheser.

Although the Town Council do not undertake the removal of excrement, they lend their assistance by letting out "tuns" for the purpose. Doubtless the fact that a charge is made for these tuns discourages frequent emptying of cesspits and of cesspools.

House Refuse is removed twice weekly by the Town Council, and deposited upon an open space near the cemetery to the east of the town.

Isolation Accommodation.

In 1888 the Local Government Board after a local inquiry sanctioned a loan for the purposes of an isolation hospital. The hospital is situated in the Spitalfields Road, to the north-east of the city, on a site consisting of some 3 acres of land. The present buildings consist of what is practically a slight modification of the Board's plan B., *i.e.*, of a block of six compartments, three of which face in one and three in an opposite direction. Each group of three consists of a large ward 24′ × 18′ × 13′, a nurses' anteroom 14′ × 14′ × 13′, and a small ward for one bed 12′ × 12′ × 13′. There is thus, upon a basis of 2,000 cubic feet per bed, accommodation for, say, at most eight patients in all. If, however, two diseases are being treated in hospital at the same time, there is obviously at most accommodation for but four cases of each disease, *i.e.*, three of one sex and one of the other. Clearly the accommodation is insufficient for the population of the now extended district. There is also an administrative block, consisting of a kitchen, sitting-room, and scullery on the ground floor, and three bedrooms on the first floor. In addition, there is a block of outhouses, comprising a laundry, disinfecting room, mortuary, ambulance house, fuel house, tool shed, and w.c. The ambulance is a converted brougham; but it has not been so modified as to enable a patient to be introduced into the vehicle in a recumbent position, a point of considerable importance in some instances.

Disinfecting Apparatus.

The Town Council have not provided proper disinfecting apparatus; instead, fumigation with sulphur of clothing and bedding is practiced in one of the outhouses at the hospital. It is to be regretted that the

Authority possess no apparatus such as would serve for satisfactory disinfection of such articles. Possibly one of the outhouses in question might be dealt with so as to afford proper housing accommodation for a modern "disinfector," one room being used for infected, the other for disinfected, articles.

Byelaws.

At the time of the outbreak the Town Council had no byelaws in force. Byelaws, however, relating to new streets and buildings, and to other sanitary matters, have been submitted to the Local Government Board, with a view to their being put in force in the district.

Adoptive Acts.

The Infectious Disease (Notification) Act, 1889, is in force in this district, as also is Part III. of the Public Health Acts Amendment Act, 1890, and the Private Streets Works Act.

Regulations.

The Town Council have made regulations under the Dairies, Cowsheds, and Milkshops Orders, 1885 and 1886. The cubic space required for each cow is 800 feet.

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App. A, N

On Enteri
Fever in
Chichester
by Dr. Th
son and
Colonel M

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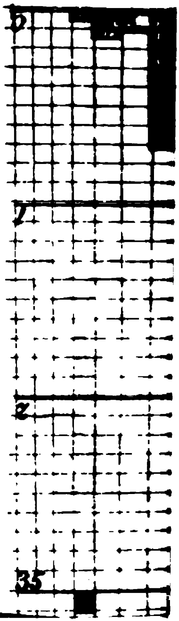

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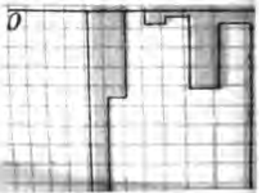
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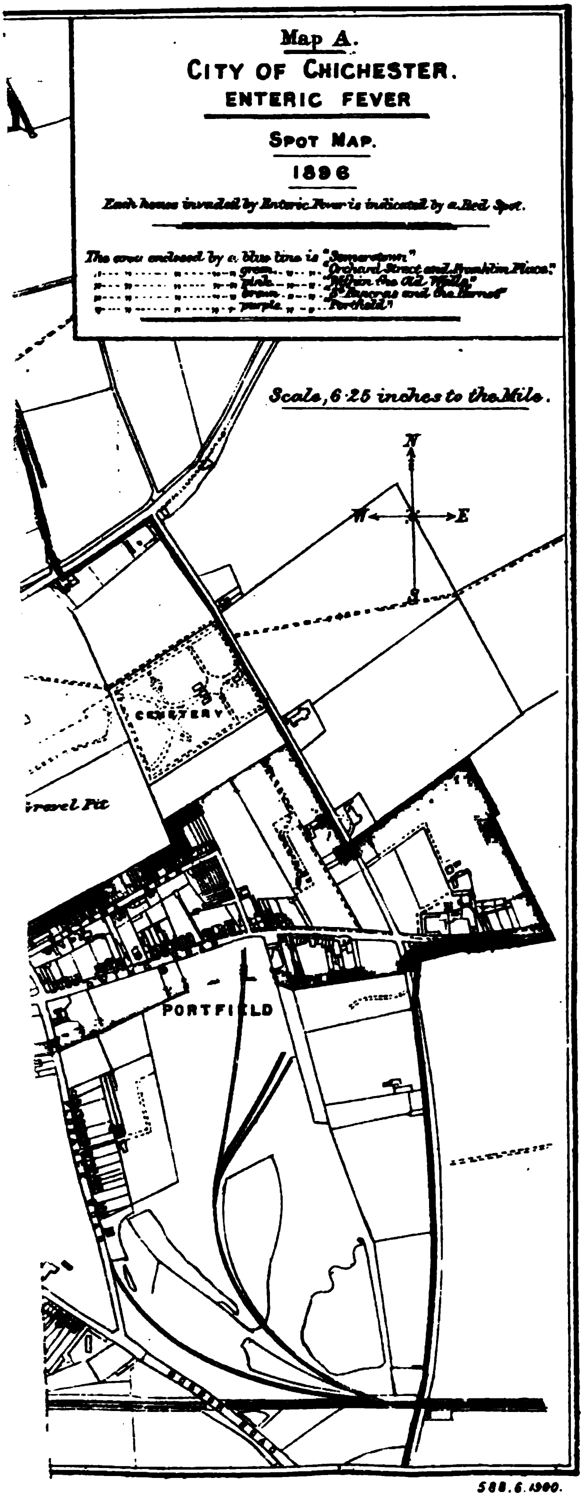

Map A.

CITY OF CHICHESTER.

ENTERIC FEVER

SPOT MAP.

1896

Each house invaded by Enteric Fever is indicated by a Red Spot.

The area enclosed by a blue line is "Somerstown"
" " " " green " " "Orchard Street and Franklin Place."
" " " " pink " " "Within the Old Walls"
" " " " brown " " "St Pancras and the Hornet"
" " " " purple " " "Portfield"

Scale, 6·25 inches to the Mile.

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APP. A

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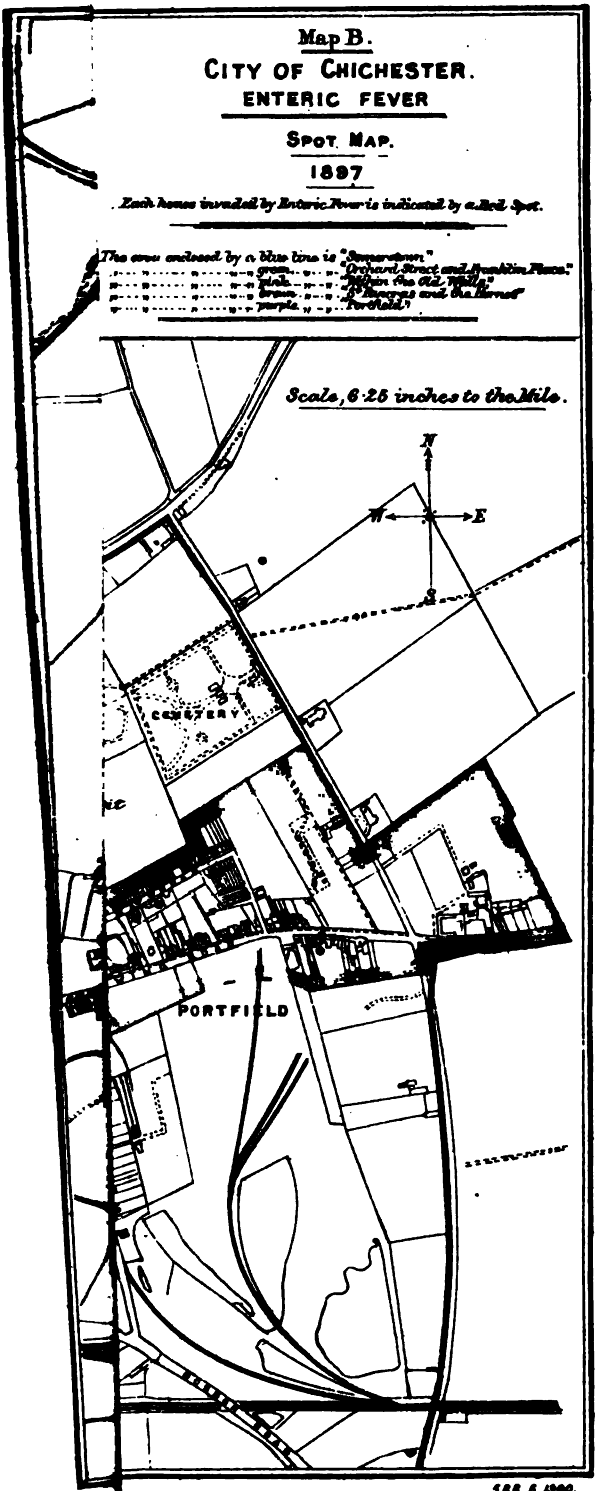

Map B.

CITY OF CHICHESTER.

ENTERIC FEVER

SPOT MAP.

1897

Each house invaded by Enteric Fever is indicated by a Red Spot.

The area enclosed by a blue line is "Somerstown"
" " " " green " " "Orchard Street and Franklin Place."
" " " " pink " " "Within the Old Walls"
" " " " brown " " "St Pancras and the Hornet"
" " " " purple " " "Portfield"

Scale, 6·25 inches to the Mile.

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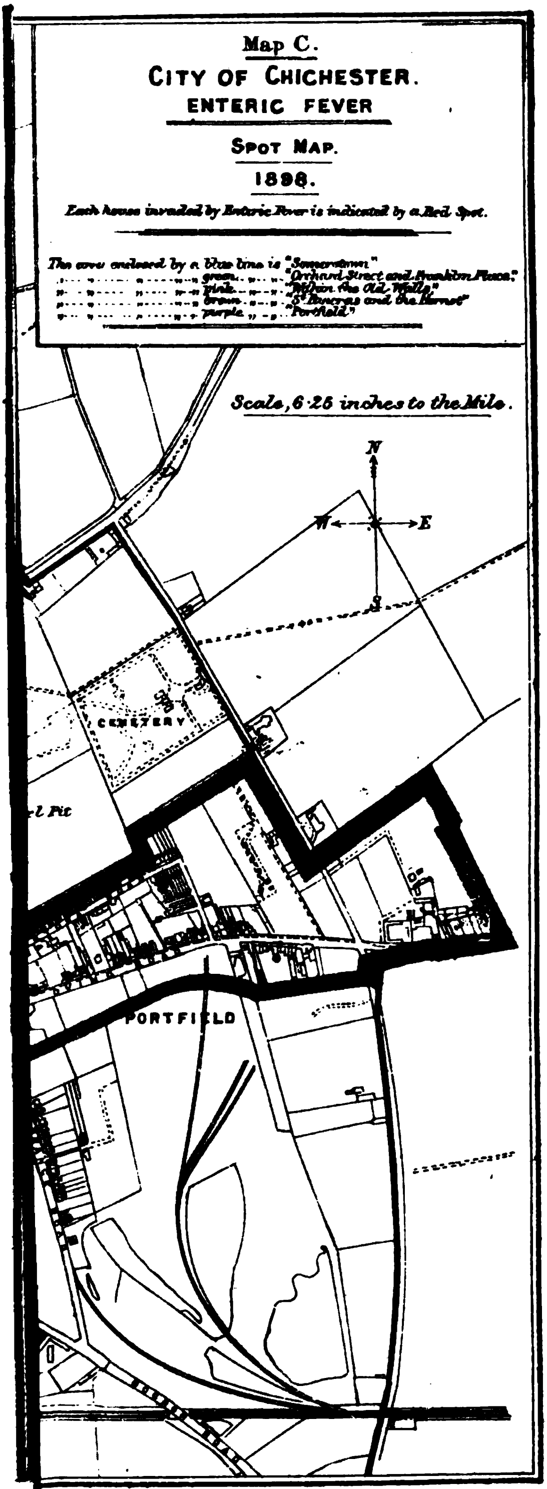

Map C.

CITY OF CHICHESTER.

ENTERIC FEVER

SPOT MAP.

1898.

Each house invaded by Enteric Fever is indicated by a Red Spot.

The area enclosed by a blue line is "Somerstown"
" " " " green " " "Orchard Street and Franklin Place."
" " " " pink " " "Within the Old Walls"
" " " " brown " " "S^t Pancras and the Hornet"
" " " " purple " " "Portfield"

Scale, 6·25 inches to the Mile.

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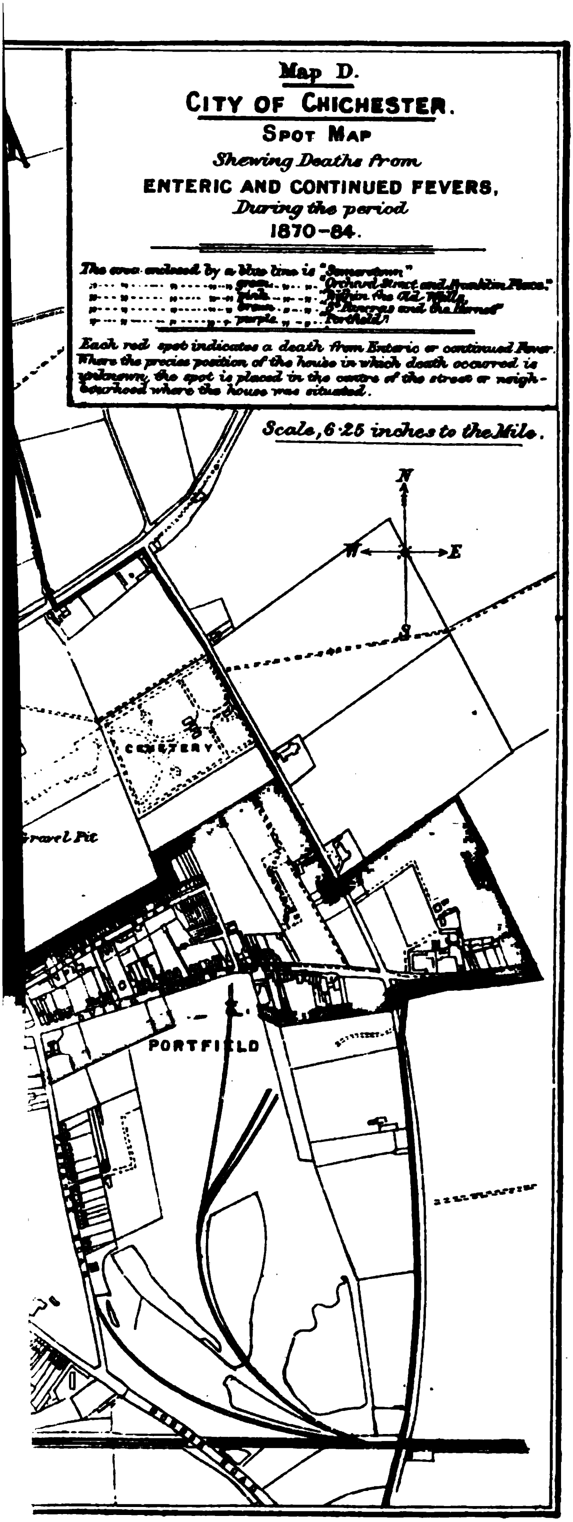

Map D.

CITY OF CHICHESTER.

SPOT MAP

Shewing Deaths from

ENTERIC AND CONTINUED FEVERS,

During the period

1870–84.

The area enclosed by a blue line is "Somerstown"
,, ,, ,, ,, green ,, ,, "Orchard Street and Franklin Place."
,, ,, ,, ,, pink ,, ,, "Within the Old Walls."
,, ,, ,, ,, brown ,, ,, "St Pancras and the Hornet"
,, ,, ,, ,, purple ,, ,, "Portfield."

Each red spot indicates a death from Enteric or continued Fever. Where the precise position of the house in which death occurred is unknown, the spot is placed in the centre of the street or neighbourhood where the house was situated.

Scale, 6·25 inches to the Mile.

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Map E.

CITY OF CHICHESTER.

SPOT MAP

Shewing Deaths from

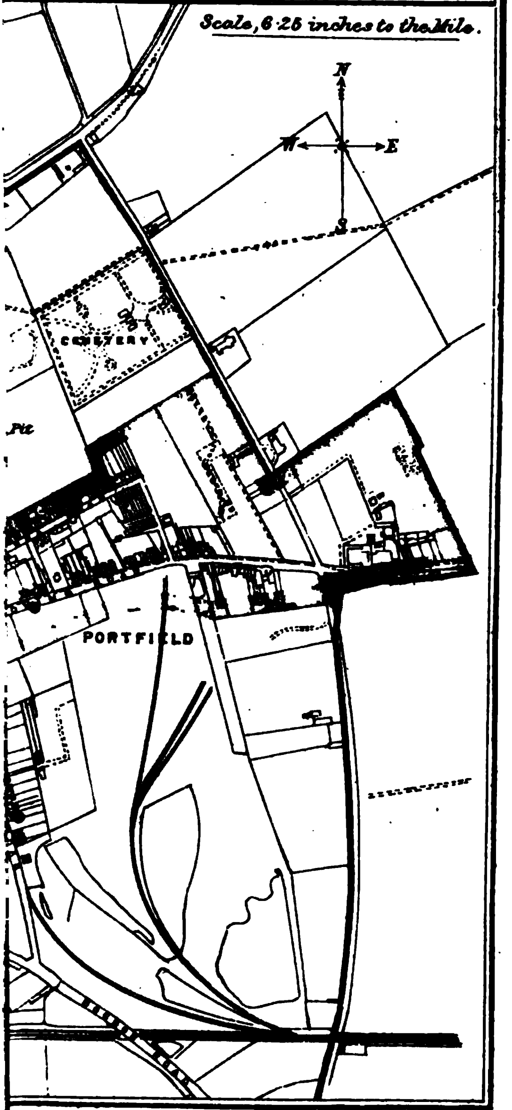
ENTERIC FEVER.

1885 TO 1898.

The area enclosed by a blue line is "Somerstown"
„ „ „ „ green „ „ "Orchard Street and Franklin Place."
„ „ „ „ pink „ „ "Within the Old Walls"
„ „ „ „ brown „ „ "St Pancras and the Hornet"
„ „ „ „ purple „ „ "Portfield"

Each red spot indicates a death from Enteric Fever. Where the precise position of the house in which death occurred is unknown, the spot is placed in the centre of the street or neighbourhood where the house was situated.

Scale, 6·25 inches to the Mile.



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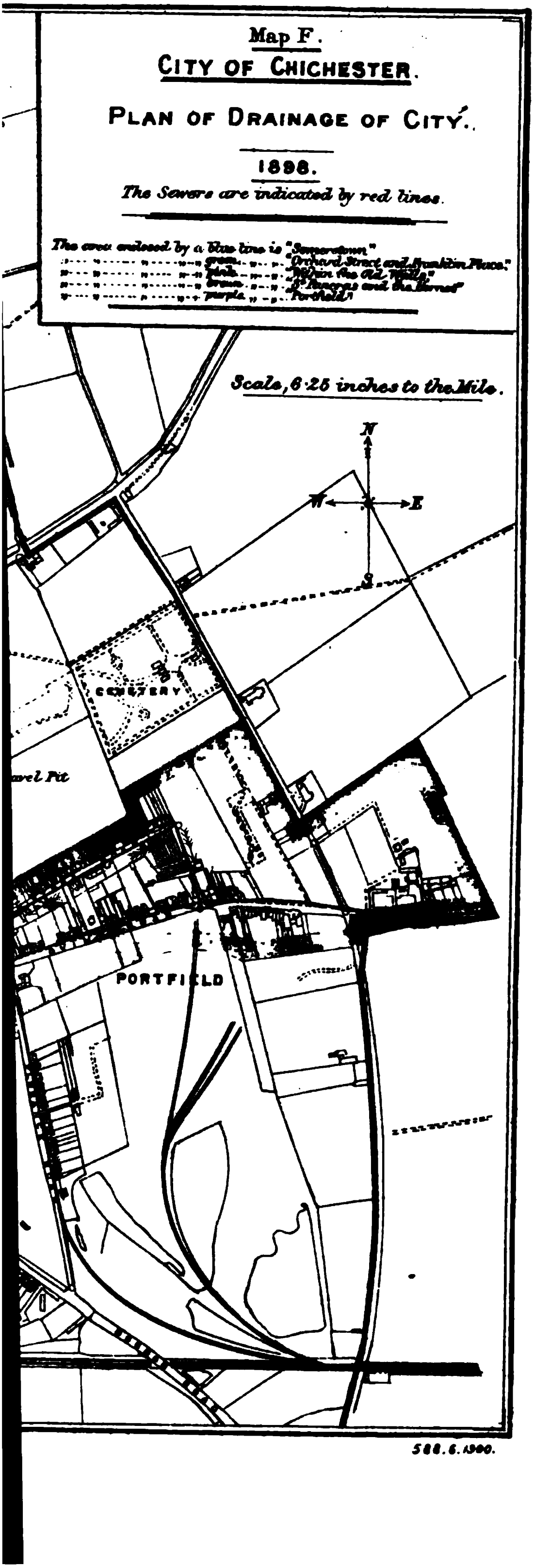
Map F.

CITY OF CHICHESTER.

PLAN OF DRAINAGE OF CITY.

1898.

The Sewers are indicated by red lines.

The area enclosed by a blue line is "Somerstown"
" " " " green " " "Orchard Street and Franklin Place."
" " " " pink " " "Within the Old Walls."
" " " " brown " " "St Pancras and the Hornet"
" " " " purple " " "Portfield"
Scale, 6·25 inches to the Mile.
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APP. A, No. 8.

On the Sanitary Condition and Character of the Administration of the Borough of Windsor; by Dr. Bulstrode.

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No. 8.

REPORT upon the SANITARY CONDITION of the BOROUGH of WINDSOR, and upon the CHARACTER of the TOWN COUNCIL'S ADMINISTRATION; by Dr. H. T. BULSTRODE.

APP. A, No. 8.

On the Sanitary Condition and Character of the Administration of the Borough of Windsor; by Dr. Bulstrode.

The sanitary condition of the Borough of Windsor has on more than one occasion been matter for the Board's consideration, and public attention has been from time to time attracted to it in this sense by the Medical Journals and by the lay press.

As long into the past as 1858, Sir James Clark, Physician to Her Majesty Queen Victoria, represented to the Lord President of the Privy Council that typhoid fever was prevailing epidemically at Windsor, and Sir John—then Mr.—Simon, K.C.B., F.R.S., together with Mr. Austin, of the Engineering Department, inquired into the outbreak. It is of interest historically, and, as will be seen later, not without bearing upon the subject-matter of the present report, to note that "in parts of the town common nuisances abounded; offensive pigsties, unregulated slaughter-houses, heaps of unremoved refuse, or puddles of obstructed surface-drainage; and where there were street-inlets to sewers stenches were loudly complained of. Though a local company was pumping reasonably good water from the Thames, three-fifths of the houses were not supplied from this source, but obtained their water from surface wells."

In 1885 the "Lancet" sent down a special commissioner to investigate the condition of the poorer parts of Windsor, and in consequence, it would appear, of the allegations subsequently made by that journal and by the lay press as to the sanitary condition of Windsor, a deputation of the Town Council, on September 14, 1886, waited upon the Right Hon. C. T. Ritchie, M.P., at that time President of the Local Government Board. The object of the deputation was to petition Mr. Ritchie to appoint an Inspector who should by personal investigation ascertain the facts as to the representations which had been publicly made concerning the sanitary condition of the Borough.

To this request on the part of the Town Council Mr. Ritchie at once acceded, appointing Dr. Hubert Airy, of the Medical Department, and Mr. Arnold Taylor, of the Engineering Department, to inquire into and report upon the matter. These gentlemen subsequently issued a report dated January 17, 1887, and in connection with the sanitary condition of the Borough they made certain specific recommendations. Following upon this report some correspondence took place between the Town Council and the Board, and in the end, with the view of ascertaining how far the Council had carried out the Inspectors' recommendations, Mr. Ritchie instructed Dr. Airy and Mr. Arnold Taylor to revisit Windsor, and to report what progress was being made. In a report dated January 23, 1890, the Inspectors described in detail what had been done, and what still remained undone.

On July 9, 1899, Mr. William George Stoneham, of 53, Thames Street, Windsor, a ratepayer of the Borough, and a member of the Berkshire County Council, forwarded a communication to the Board in which he complained that the Town Clerk had apparently "taken upon himself to suppress" a certain report of the Medical Officer of Health having relation to the insanitary condition of Victoria Cottages; and on July 27, 1899, Mr. Stoneham wrote asking whether the Board "will hold a public inquiry as to the illegal conduct of the Town Clerk in suppressing the Report or Reports of the Medical Officer of Health."

After some further correspondence between the Board, the Town Council, and Mr. Stoneham, I was instructed to visit Windsor, and "to inquire into and report upon Mr. Stoneham's representations, with special reference to the extent to which insanitary conditions of the kind pointed out in 1887 and 1889 by Dr. Airy and Mr. Arnold Taylor are still existing."

During my inspection of the district I was fortunate enough to be accompanied at one or another time by several members of the Town Council, who took interest in the subject of the inquiry, and who were evidently desirous to make themselves acquainted with the sanitary conditions which they had been elected to control. Among those who thus accompanied me were Alderman Thomas Dyson and Alderman J. L. Hollis. Councillors Bruce Porter, F. T. Ryland, Sir John Thomas Soundy, and Bernard Westlake, the chairman of the Health and Drainage Committee. As an instance of the open-mindedness of these gentlemen, I may mention that Alderman Dyson, before accompanying me on a round of inspection, frankly expressed regret at my visit, but at the termination of the day's inspection he as frankly withdrew his opinion, and, while deploring the existence of the conditions he had seen, expressed a hope that my visit would lead to a better state of affairs.

The Borough of Windsor is situated on the Berkshire bank of the River Thames at a point opposite to Eton. It embraces the whole of the parish of New Windsor, together with the parish of Clewer-within, and forms part of the Union and Registration District of the same name. The district is almost entirely residential in character, Windsor Castle, in fact, having given rise to, and directly or indirectly maintained for many centuries, the aggregation of houses known as New Windsor, and it was as long back as 1276, in the reign of Edward I., that the first Charter of Incorporation was granted. A regiment of the Household Cavalry occupy the Cavalry Barracks, and a battalion of the Foot Guards the Infantry Barracks.

There are, save for two breweries and an aërated water manufactory, practically no industries in the district, a large number of houses being devoted in one and another manner to the accommodation of the visitors who are attracted to the town from all parts of the Empire and, indeed, of the world. The proximity of Eton College to Windsor is, during term time, instrumental in bringing a large number of visitors to the town, and while the Ascot races are in progress many persons make Windsor their headquarters. There are two railway stations—both termini—one belonging to the G.W.R., and the other to the L. & S.W.R.

The town rests partly on rising ground consisting of bare chalk, but in the main, the poor and low-lying parts of the Borough are situated upon the river gravel which has been deposited along the course of the Thames. To the south of the Castle is a narrow strip of Woolwich and Reading beds, while the greater part of the Old Deer Park is situated on the London clay. From a sanitary standpoint it is of importance to note that the greater portion of the population of Windsor is housed upon a permeable bed of gravel.

The main street of the Borough, Thames Street, a wide and relatively imposing thoroughfare, is flanked on one side for much of its extent by Windsor Castle, and on the other by some of the principal business houses and hotels in the Borough. This thoroughfare was apparently much improved by the late Prince Consort, who, in 1852 and 1861, was instrumental in removing some old houses and shops which then stood beneath the Castle walls, and added to the street the spaces so gained. I am informed by the present Mayor (A. T. Barber, Esq.), and I gather from his illustrated pamphlet on "Windsor in the Last Century," that the old pump which still stands in the roadway near the base of "the hundred steps" was, before the improvements above referred to took place, in the passage of the "Crispin Inn." It seems to have been the intention of the Prince Consort to have also demolished the block of houses to the north of the Guildhall, but this project was never carried out.

The chief business thoroughfare is Peascod Street, which runs from Castle Hill to the lowlands to the west of the town. This street is of considerable antiquity, and there is frequently but little space behind the houses abutting upon it. A certain portion of the low-lying part of Windsor near the Thames is liable to be inundated during periods of flood in the Thames valley, and with a view to mitigating the results of such inundation the Town Council in 1887 obtained the sanction of the Board to the adoption of certain byelaws providing for the elevation of the sites of proposed houses. The enforcement of these byelaws has, I hear, been attended with good results.

POPULATION.

The Medical Officer of Health, Dr. Edward Casey, estimated the population of the Borough to Midsummer 1898, at 12,715; but he gives reasons, such as the large number of houses, for believing that this estimate is considerably below the true population.

At the census enumeration of 1861, the population amounted to 9,520, in 1871 to 11,769, in 1881 to 12,273, and in 1891 to 12,527.

Water Supply.

The shallow wells referred to in the report of Sir John Simon as existing in the Borough at the date of the typhoid epidemic in 1858, have now, through the praiseworthy action of the Town Council, almost entirely disappeared, and the district is at present supplied from the waterworks belonging to the Corporation and situated at Eton. These waterworks were acquired by the Corporation from the Windsor and Eton Waterworks Company, under the powers conferred by the provisions of the "Windsor Corporation Water Act, 1884."

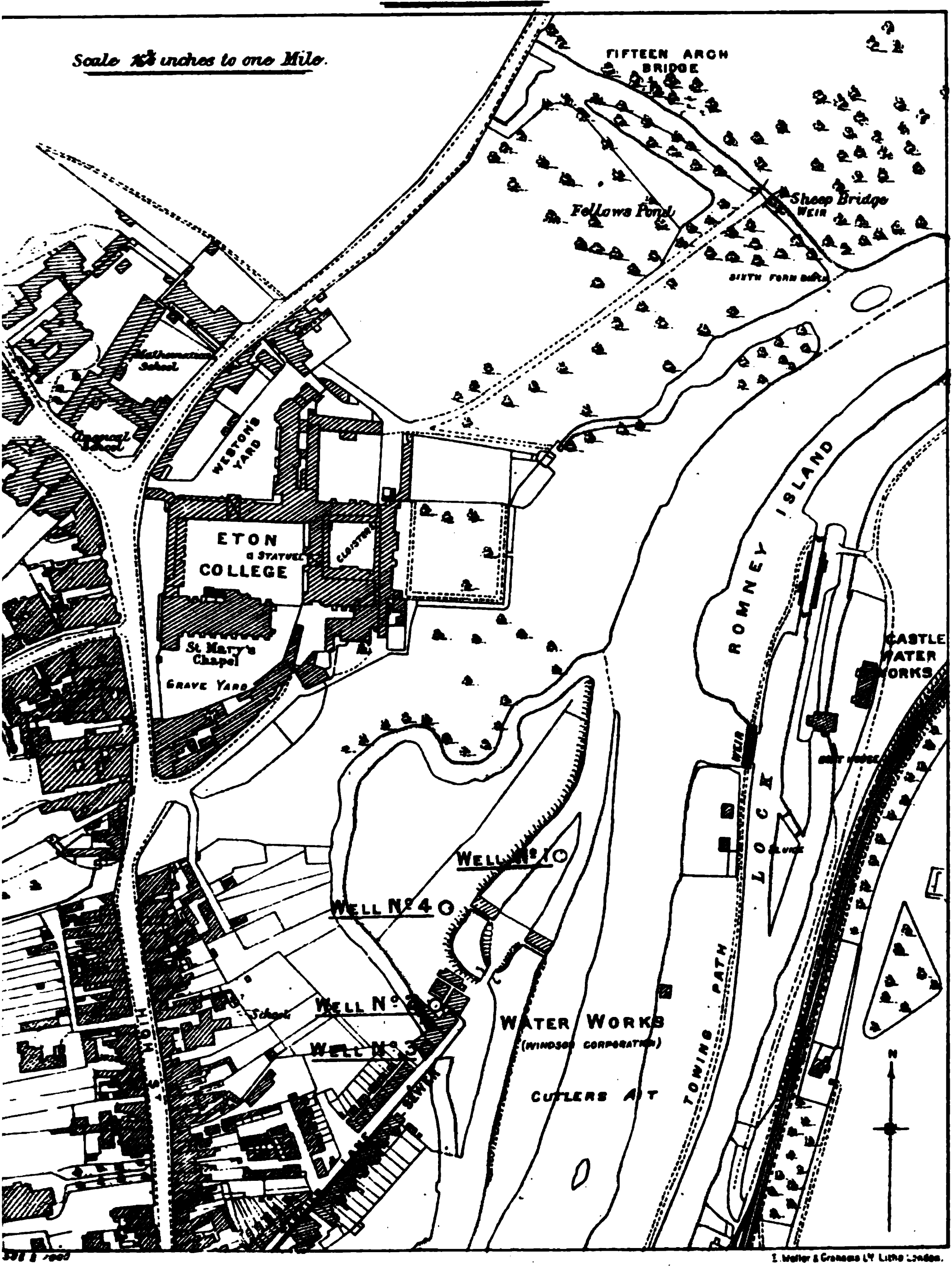
The water is derived from wells situated near to Eton College, most of them on an island known as Tangier Island. A map (16⅗ inches to the mile) is annexed indicating the precise position of those wells. It will be noted that three of the four wells now in use are cut off from the mainland by means of a stream or streams. These wells are 26 to 28 feet in depth, the greater portion of this depth being sunk in the river gravel which hereabouts overlies the Chalk. This gravel, which is of a somewhat fine character, is said to be 20 to 24 feet in depth.

Each well is some eight feet in diameter, and is lined internally by cast-iron cylinders. These cylinders, with the exception of the uppermost, are all perforated in such a manner as to allow of, or rather to encourage, the gravel-water entering the wells. Owing to the increased demand for water, an attempt was made a few years ago to bore down into the chalk at the bottom of well No. 2, but, although 135 feet 6 inches of chalk was perforated, the additional yield of water was practically nil, a fact which would in itself appear to militate against the probability of there being fissures in the chalk hereabouts. In consequence of the failure to procure an additional supply from this source, well No. 4 was sunk, and the total supply is now, I am informed, quite sufficient for the present needs of the district.

Above the level of the uppermost iron cylinder, which, as has been already observed, is not perforated, and which reaches to within a few feet of the surface, the walls are lined with bricks set in cement, but in well No. 3 there is a considerable area covered with concrete. The top of the wells has been raised above the level of the surrounding ground in order to prevent the entrance of river water during times of exceptional flood in the Thames valley; for instance, in 1894 the water actually overflowed into certain of the wells. There is no provision for storage, the water being pumped direct into the mains, nor is any filtration considered necessary. The Resident Engineer has advised the provision of a storage tower, and he points out that there is no storage available in the event of fire. The pumping power is furnished partly by a water wheel, partly by turbines, and partly by steam engines. These latter are only used when the head of water in the river is insufficient to drive the turbines.

Up to last summer there appears to have been some difficulty in maintaining sufficient pressure in the higher mains during periods of excessive street watering or other exceptional

MAP SHOWING POSITION OF WELLS OF THE WINDSOR CORPORATION WATERWORKS.



J. Weller & Graham Lᵈ Litho London.

demands, and I understand that during last summer the higher parts of the town were at times not adequately supplied during the presence of an exhibition which made large demands on the supply. This disadvantage, the Engineer tells me, has been now overcome by the provision of a new and powerful engine. The Corporation now supply a population of about 20,000 in Windsor, Eton, and Clewer; the daily supply being, I am told, at the rate of about 35 gallons per head.

Windsor Castle is in the main supplied by its own waterworks, which are situated near Romney Lock, but the Dean's and Canons' residences, and the Horseshoe Cloisters, which form part of the Castle, are supplied by the Corporation.

The water is now chemically examined every quarter, and by a recent arrangement on the part of the Council, the Medical Officer of Health is to be notified of the date and place at which those quarterly samples are to be taken, so as to afford him an opportunity of co-operating in the matter. It does not seem that samples have in the past been taken as regularly as could have been wished, nor has it apparently been the practice to submit a copy of the analyses to the Medical Officer of Health, and this notwithstanding the fact that he has, he tells me, represented in writing to the Sanitary Committee the desirability of this step.

It may be well here to insist upon the importance of the Medical Officer of Health being kept thoroughly informed of all matters likely in any way to affect or influence the water supplied to the community under his care. It is his duty "to inform himself as far as practicable respecting all influences affecting or threatening to affect injuriously the public health within the district," and this being so he should, in my view, be instructed to periodically visit the waterworks, and to report upon any matters which in his opinion, and in his province, require attention. He should, too, determine, in consultation with the Manager of the Waterworks, the exact spot or spots from which the samples for analysis should be collected.

It has, I understand, been the practice in the past to take the samples directly from the mains in the town, but, having regard to the fact that the water is derived from four separate wells, all in different positions, it is clearly desirable to examine from time to time the water from each well separately. A course such as this would be likely to indicate any danger to which the water of any one well might be liable. Mr. Westlake, Chairman of the Sanitary Committee, and Mr. Sainty, the Manager of the Waterworks, are, I think, alive to the desirability of these separate analyses, and on one occasion before the sinking of the new well an analysis of this description was made.

As regards the source of the water supplied to Windsor, there can be no doubt that a very considerable amount is procured through the perforations in the iron cylinders from the river gravel in which the wells are sunk. Some of the water may be filtered river water, some subsoil water travelling down the valley of the Thames. That river water filtered through the gravel found hereabouts undergoes a very material improvement

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was well shown in Section IV. of the Sixth Report of the Rivers' Pollution Commission, which deals with the water supply of the royal residences.

As regards purity, the reports of analyses have so far been favourable to the water (*see* Addendum No. 1). With respect, however, to the surroundings of the wells, it has to be noted that the one nearest the entrance gate (No. 3) is not far removed from the drains serving certain cottages in Tangier Lane, and, moreover, that the drain leading from the manager's and workmen's closets passes in proximity to both wells No. 2 and No. 3. Mr. Sainty tells me that the drain in the waterworks ground is laid in six inches of concrete, and that he periodically tests it by means of the water test; he appeared to me to be alive to the enormous importance of maintaining this drain in a thoroughly watertight condition. During the course of my inspection, I descended well No. 3 to ascertain the manner in which it was lined, as this matter had not been previously investigated. I found, a few feet from the surface, a large iron pipe, some eight inches in diameter, leading from the well in the direction of the water wheel. The engineer was unaware of the existence of this pipe, and he at once gave instructions for a plate to be made to cover its mouth.

EXCREMENT DISPOSAL AND HOUSE DRAINAGE.

Windsor is a "water-closet town," and therefore there should be no accumulation of excrement in the vicinity of houses. But up to a comparatively recent date there was a large number of closets not provided with water, and the unsatisfactory method of hand-flushing as accordingly resorted to. In the direction of remedying this defect, however, very good work has been done in the district within recent years, and to the present officials, notably Mr. Mellows, the Inspector of Nuisances, the Sanitary Authority is indebted for much of the progress in this direction I am, indeed, glad to be able to speak thus of Mr. Mellows's efforts, as in certain particulars I shall be unable to commend his more recent work.

As regards the manner in which the contents of the closets are conveyed to the sewers in certain of the poorer parts of Windsor, it is difficult to speak with any confidence, inasmuch as the nature, direction, and soundness of the house drains is usually a matter of pure conjecture. In the poorer parts of the town drain ventilation is often entirely absent, as also are any opportunities for drain inspection. Probably but few of the older drains would withstand the water test, and it does not seem that any extensive effort has been made to ascertain the exact state of affairs in this respect. Numerous instances of defective and broken traps came to my notice, and on several occasions complaints of smells from the house-sinks were made. At times these smells were obviously due to the fact that the sink waste pipes were untrapped, and imperfectly disconnected from the gullies over which they discharged. Nuisances such as these could be remedied either by trapping the waste pipe by means other than a bell trap, a large number of which are either broken or lost, or by aranging the gullies as required by the byelaws at present in force in the district.

There seems to be need for a very extended and careful examination of the house drains in the poorer parts of Windsor, with the view of ascertaining and remedying such defects as may be discovered, and providing adequate ventilation, disconnection, and trapping. In houses which have been recently constructed under the provisions of the new building byelaws proper arrangements for inspection, ventilation, and disconnection of the house drains have for the most part been made. But I found that some comparatively new houses, erected since the new byelaws have been in force, did not in certain particulars of drainage conform with such byelaws. This is the more remarkable since I was especially invited to visit these houses in order to see in what an excellent manner the modern houses were being drained. I am glad, however, to be able to record that the present Surveyor (Mr. E. A. Stickland) has put an end to mistakes of this sort, and that house drains are now being laid down in accordance with the byelaws.

SEWERAGE OF WINDSOR.

The cholera outbreak of 1849 would appear to have been instrumental in bringing about extensive sewerage and drainage operations in Windsor. Many of the sewers then laid down are still in existence.

The sewers of Windsor are, indeed, of diverse kinds, as is so often the case in old towns. Some are old brick barrel sewers; others, pipe sewers with clay joints; and others again, as, for instance, the more recent, pipe sewers with proper joints. The levels vary considerably, and in certain instances the fall of the sewer is in the opposite direction to the flow of sewage. The Surveyor tells me that he has evidence pointing to the fact that all pipe sewers laid up to as late as 1888 or 1889 were jointed with clay. When opening up the ground in making house and gully connections he has, he tells me, nearly always found clay joints; and, moreover, he finds specifications of about that date in his office distinctly stipulating for the provision of clay joints.

Flushing of sewers is carried out by a series of flushing tanks fixed at convenient and effective points in the system. There are 35 such flushing tanks, each with a capacity of some 1,000 gallons, nine of the tanks being automatic and the remainder hand-worked. The latter are discharged according to the exigencies of the situation; the former are arranged to discharge weekly. In addition to these 35 flush tanks there is a sluice valve near Windsor Bridge, which enables Thames water to be conducted directly into the sewer, and the present Surveyor regards the provisions generally for flushing as now being adequate.

Order procured in 1893, and with the sanction of the Local Government Board, additional land, and they now possess 50 acres of land, some 39 of which can be used for sewage disposal purposes.

The ground is laid out in a series of plots of various sizes separated from one another by raised banks, but not all the plots so laid out are used for irrigation at the present time. The area used, or likely to be used for sewage irrigation is surrounded by a raised bank to obviate the flooding of the farm when the Thames overflows its banks. The method of working is to turn upon any given plot as much sewage as it will hold between the raised banks which separate the plot, and to allow the sewage to soak away at leisure. This process is repeated when the sewage has soaked away, and the surface of the field is considered by the resident engineer to be capable of receiving a further inundation. When this soaking and drying process takes to long the land is ploughed over before being again used, and from time to time certain plots are given over to agriculture. At the date of my visit the plot which had that day been used was covered to a considerable depth with sewage, upon the surface of which swans were floating.

Certain plots dry much more rapidly than others, a fact doubtless to be accounted for by the varying degrees of porosity of the soil and subsoil. Vegetation would appear to be quite a secondary consideration at the farm; but, certain plots are from time to time leased to farmers.

REFUSE STORAGE, COLLECTION, AND DISPOSAL.

House-refuse is stored partly in ashpits and partly in movable receptacles. In this matter of storage there is room, however, for much improvement in the poorer parts of Windsor. In several instances I found the ashpits much dilapidated, or altogether broken down, and frequently there was no provision for storage whatever.

The accumulation of heaps of refuse, partly vegetable and partly animal, upon the bare ground cannot upon general principles have other than a prejudicial effect upon the public health and comfort. In times of rain this decomposing refuse is washed into the subsoil in the neighbourhood of inhabited houses, and in times of drought and wind is scattered broadcast. This aspect of public health control in the Borough has, there can be no doubt, been much neglected. Furthermore, as a member of the Town Council aptly pointed out during the course of my inspection, neglect of this character is likely in the case of a yard used in common to facilitate the spread of specifically infected rubbish.

There seemed locally to be some little doubt as to what are the powers of a sanitary authority in reference to this matter, but I was unable to ascertain that the Town Clerk, the legal adviser of the Council, had been consulted upon this subject.

It may therefore be pointed out that Section 36 of the Public Health Act, 1875, enacts that if any house appears to the local authority, by the report of their surveyor or inspector of nuisances, to be without a sufficient water-closet, earth-closet, or privy, and an ashpit furnished with proper doors and coverings, the local authority shall enforce provision of such accommodation, and, further, by the provision of Part I. (Section 11) of the Public Health Acts Amendment Act, the expression "ashpit" is held to include any ash-tub or other receptacle for the deposit of ashes, fœcal matter, or refuse.

For the purpose of the collection of house-refuse, the district is divided into six scavenging areas, and the refuse of each area is collected at least once weekly, while in certain quarters, where such a procedure is deemed desirable owing to the nature of the locality or the habits of the people, the refuse is collected twice weekly. The barrack refuse is collected daily. All this is done free of charge by the Corporation. The refuse was, at the time of my visit, being used to raise the level of some low-lying ground just beyond the Borough boundary, and not far removed from certain houses. The Board have, since the date of my visit, received a complaint of a nuisance caused by this deposit of refuse, and the use of this spot for the purpose has now, I understand, been discontinued—at least so far as the Corporation is concerned.

The actual collection of refuse seemed to me to be carried out in accordance with the arrangements laid down by the Council, and no neglect in this particular came under my notice.

Plans for a refuse destructor have been prepared, and the Town Council hope to shortly proceed with the erection of this desirable addition to their equipment.

ISOLATION ACCOMMODATION.

Although the question of hospital accommodation for the Borough of Windsor has been from time to time considered by the Town Council, the inhabitants of the district are still, at least in so far as diseases other than small-pox are concerned, without the advantages of such an institution.

For small-pox there is a "temporary" corrugated-iron hospital, situated alongside the sewage farm. This was erected in 1893, to cope with an epidemic of small-pox, and when, in the words of the Medical Officer of Health, "it became evident that the disease had attained a footing in the town." The hospital is of the usual "temporary" character, but there has recently been erected in connection with it an inexpensive brick building, consisting of six rooms, which, I am informed, it is intended to use for purposes of administration when the small-pox hospital is occupied.

Sundry attempts have been made to acquire a site for an isolation hospital, but hitherto no success has attended them. During 1890-1892 negotiations were carried on with the Windsor Castle authorities, as also with the Windsor Rural Sanitary Authority, but apparently without avail. On one occasion

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matters were, it appears, nearly arranged, but the conditions imposed by the Office of Works were considered too stringent by the Town Council.

It is deplorable that a Borough such as Windsor should still be without a properly-equipped isolation hospital, more particularly as many of the poor of Windsor live under conditions in which proper isolation at their houses is altogether impracticable.

It has, however, to be noted, in reference to delay in providing isolation accommodation on the part of the Town Council, that the views of the present Medical Officer of Health as to the advantages of an isolation hospital are not those held by the vast majority of his colleagues in the Public Health Service, and, this being so, that he has not pressed the matter upon the Sanitary Authority, as he perhaps ould have done had his views been more in keeping with current ideas.

The attitude of the Medical Officer of Health in this, as in several other matters connected with the health of the Borough, would seem to be somewhat apologetic, and he has thus summarised his views as to an isolation hospital:—"I have advised the Sanitary Authority that such an institution would be of great convenience, especially to the middle and upper classes, and that perhaps public opinion demanded it; but, on the other hand, I could not hold out hopes that the provision of such an hospital would in any considerable degree influence the prevalence or mortality of these diseases. All obtainable evidence seems to me to forbid any more encouraging anticipation, and our local experience points unmistakeably in the same direction; further, I have advised that the concurrence of 'Clewer Without' should be in any case a *sine quâ non*."

It is impossible in a report of this nature to discuss the general question in detail. But I may point out that the usually recognised object of an isolation hospital is to benefit rather the poorer classes than the upper and middle classes, who are commonly able to make arrangements for the isolation of infectious cases in their own homes; and that to be of use an hospital of this nature should be in readiness to isolate the first cases, rather than be erected, as appears to have been the case with the small-pox hospital, when it is evident "that the disease had attained a footing in the town."

In other words, it is the object of an isolation hospital to prevent this very footing which is here alluded to. The advantages of an isolation hospital may, I think, be thus fairly summarised:—

(1.) It enables the sick to be separated from the healthy, and the healthy to proceed with their occupation or education, as the case may be. The advantage of this is more likely to be experienced, not, as Dr. Casey seems to imagine, by the middle and upper classes, but by the poor, in whose two-roomed houses isolation is quite impracticable.

(2.) The provision of better medical control and nursing than is possible in the houses of the poor.

(3.) The minimising of the risks of infection from invaded households to the remainder of the community.

It should, however, be pointed out, in justice to Dr. Casey, that his practice in dealing with infectious diseases, other than small-pox, is to at once himself visit the invaded house and to enquire as to the source of infection, to advise as to precautions, and to prohibit, where necessary, the attendance at school of any children from the same house, and to make arrangements, if he consider it desirable, for the workers in the house to live away from the infected dwelling, or to discontinue their occupation. The Sanitary Authority under these circumstances allow, within limits, compensation to the worker. From time to time the Inspector visits the house, and at the termination of the illness disinfects the rooms and removes the bedding to Slough for disinfection by steam. The school authorities are also informed by the Medical Officer of Health when children from the invaded house may attend school again. In cases of supposed diphtheria a bacteriological examination of the throat secretion is provided for by the Sanitary Authority.

All these regulations are no doubt excellent, but they by no means render an isolation hospital unnecessary. Furthermore, the expense of providing lodgings for the workers, or of compensating them for abstention from work, must, if carried out in all cases where necessary, be considerable, and even the former measure does not, as far as can be seen, do away with the risk of conveying diseases to other houses or to the workshops, etc. There would appear to be no provision in Dr. Casey's scheme for disinfection of the workers' clothes or for preventing the attendants upon the sick from conveying the disease. Moreover, in many of the houses which I visited it was, in my opinion, quite out of the question to properly isolate infectious disease.

DISINFECTING APPARATUS.

The Town Council have not as yet erected any disinfecting apparatus, and, up to 1896, no provisions were made for the use of one. Since that date, however, arrangements have been made with the Slough Urban District Council for the disinfection of certain infected articles at the steam disinfecting station at Slough. For the disinfection of rooms the Equifex Spray is used.

THE HOUSING OF THE WINDSOR POOR.

Upon this subject much has been written, and not a few sermons have been preached, but it would be outside the scope of this report to do other than furnish certain facts, and indicate inferences which may be legitimately drawn from them.

During the course of my inspection of the district, I visited a considerable proportion of the worst parts of Windsor, but it would be inconvenient here to reproduce the whole of my somewhat voluminous notes on the subject. I propose therefore to confine myself to certain examples which illustrate the conditions which obtain, and the methods adopted in dealing with them.

I commence my observations with a consideration of Victoria Cottages, partly because it was a report relative to the condition of these cottages which was instrumental in bringing to light the facts here set forth, and partly because these cottages are not regarded locally as being by any means the worst in Windsor. Viewed from the outside, Victoria Cottages present no very remarkable appearance—they consist of about a hundred cottages situated in the lower part of Windsor, and abutting upon Goswell Road, Grosvenor Road, Denmark Street, and Edward Square. Those abutting upon Goswell Road and Edward Square have, separating them in the rear, an open space which is cut up into small gardens or "yards," one for each house. Many of these houses have lean-to wash-houses with adjoining w.c.'s. The roof over these structures is continuous from one house to another, and as there is no ceiling there is often aërial communication between the w.c. of one house and the wash-house of that adjoining. As a result of this, smells are often and loudly complained of. The "yards" are for the most part unpaved, and in several instances the contour of the ground is such that, in times of rain, the surface drainage from the "yards" abutting upon Goswell Road flows down and inundates the "yards" of houses abutting upon Denmark Street. In the rear of these houses the gullies are often defective, and the rain-pipes broken, while in numerous instances the house-refuse is deposited in heaps upon the ground, there to soak into the soil or to be blown about by the wind according to the meteorological conditions prevailing at the time.

These circumstances are sufficiently unsatisfactory, but it is in reference to the non-weather-proof condition of these houses that the most serious considerations arise. I inspected a very considerable percentage of these houses, with a desire to obtain a good average idea of the state of affairs existing. I was especially invited to enter certain houses, the tenants beckoning to us to inspect their abodes and to see the conditions under which they were obliged to live. There was distinctly a pathetic side to this inspection of Victoria Cottages, the inmates seeing members of the Town Council with me, thinking that at last, at any rate, there would be some redress.

A few extracts from my notes will be, perhaps, the best means of showing the condition of affairs, distinguishing each house by a separate letter of the alphabet.

A. Leakage through ceiling in both bedrooms.

B. Ditto.

C. Roof recently repaired, but is rapidly getting out of repair again.

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D. Gully stopped and overflowing.

E. When there is rain, backyard always flooded with water from adjoining yards. Roof leaks and rain pipe out of order. Tenant has told rent collector about defects until "she is sick of it." Rent was 4*s.* 3*d.* a week, but is now 5*s.*, it having been raised about 18 months ago on the plea that repairs were to be undertaken.

F. Ceiling falling down in sitting-room; bad smells from drain in scullery. Leaks remedied in upstair rooms within the last two months.

G. Roof of wash-house and of bedroom both unsound and leaking. Have "always leaked." Rent raised some time ago from 5*s.* 4*d.* to 6*s.* 6*d.* per week.

H. Water comes through ceiling and drips on to floor; going on in this way for very many years past. Has had to move beds in *both* bedrooms to avoid rain.

I. Rain comes into bedrooms—water utensils placed in both bedrooms to catch rain. Has been in this condition for the last three or four years.

J. Rain drops on to both beds. Wash-house leaks; rain pipe broken in adjoining house.

K. Rain pipe broken. Asked what stains in ceiling were, answered: "That's where it poured on us when we were in bed; baby was taken out of bed wringing wet through."

L. Tenant has had rheumatism from lying in wet bed due to leaky ceiling; pails in both rooms to catch rain. Heaps of refuse in yard. Wash-house leaks. Hole in floor of passage.

M. Rain-pipe out of order; gully broken. Had to move beds the other night because of the rain. Rent 6*s.* 6*d.* per week.

N. Communication in wall between wash-house and water-closet of adjoining house. Complaints of smell from adjoining w.-c. Tenant gets "sopping wet through" when it rains while she is in wash-house.

O. Smell from sink. Leakage from w.-c. of adjoining premises used to escape through wall, but now remedied. Roof was repaired about six months ago, but rain now comes in again.

P. Rain has dripped on to bed for last two years. Wash-house ceiling falling in. Floor falling in. Rent 6*s.* 6*d.* per week; no repairs carried out.

Q. Ceiling falling down in wash-house.

R. Rain coming through roof, in spite of recent "repairs." Rain coming in all over ceiling.

S. Some repairs carried out, but ceiling coming down in wash-house, and rain still comes into one of the bedrooms.

T. Still "swamped out" when it rains, and some of the ceiling has fallen down in bedroom since "repairs"; in fact, rain comes in *much* worse since "repairs" were executed. Before repairs, *one* receptacle used to serve to catch the rain coming through ceiling, now *seven* were usually used. Smell from adjoining closet comes through into wash-house. It should be noted that this house is supposed to have been recently put in order.

A perusal of these notes will convey what, I think, all who accompanied me on my inspection will admit is a fair general idea of the conditions obtaining.

In some instances papering and whitewashing of the cottages have been quite recently carried out under the order of the Town Council, and as the result of reports in which the Medical Officer of Health, the Surveyor, and Inspector of Nuisances have all had a share; but even in these houses with unsound roofs the condition of the roofs was usually the same as before the repairs commenced, or the efforts at repair had resulted in a state of affairs no better or even worse than before. (*See* reference T. above.) It has to be borne in mind that the defects noted had been in existence, in several cases for many years, and that notwithstanding the action recently taken by the Town Council with regard to a certain number of these Victoria cottages, it was difficult to regard them as suitable for healthy habitation. The action of the Corporation seemed indeed to have been lukewarm and hesitating, and in some manner or other restrained. It is not by such measures as had here been taken by the owners that permanent improvement is to be brought about.

RIVER STREET, FORMERLY BIER LANE.

This street has figured prominently in the insanitary history of Windsor, and Dr. Airy and Mr. Arnold Taylor devoted attention to it in their report. It is situated between Thames Street and the River Thames, and a capital view of it can be obtained from the Castle walls near to the Curfew Tower. On the east side of the street as it opens out from Thames Street is a butcher's shop, to which a slaughter-house is attached. The side of the house which abuts upon River Street, and which is prominently noticeable from Thames Street, is much dilapidated, the plaster being detached in several places. It is difficult to understand why this state of affairs has been allowed to continue, but it appears that there has been question for some time past as to whether the whole building should not be demolished to increase the width of the entrance to River Street. This project has now, I understand, been given up, and, hence, it is to be hoped that those responsible for the condition of the premises will see to these repairs. A little beyond the slaughter-house, which, although situated in very undesirable proximity to the dwelling-house, has been greatly improved through the instrumentality of the present Sanitary Inspector, and which was in a cleanly condition on the day of my visit, is a courtyard known as Providence Place. This courtyard is asphalted, but the asphalt is in a very dilapidated condition, and badly requires mending. The ashpit in the yard is broken down, and has evidently been in this condition for a considerable time; one of the w.c.'s is also out of order. On the opposite side of the road, and at the end farthest from Thames Street, are several houses which are let out in tenements. These houses are, for the most part, in a most dilapidated condition. The staircases are in places unsafe, the walls broken and dirty, while similar conditions obtain in certain of the rooms where the floors and ceiling are dilapidated. Complaints have, we were told, been made, but no assistance has been rendered. In certain of these rooms there are evidences of overcrowding, judged by the minimum standard of 300 cubic feet of space per adult. In the yard belonging to one of these houses is a gully in an eminently unwholesome condition; it should have served for the drainage of the yard, but the brick paving surrounding it is broken away, and the water, instead of entering the gully, has permeated and excavated the ground around. The resulting stench is highly offensive, and it is clear that the condition is not an affair or yesterday. In the yard adjoining this there is no means of surface drainage, but to provide for the deficiency the tenant had a long time previously dug a hole in the ground in the yard which is supposed to act as a sort of "soak away." This, however, has become choked up, and in times of heavy rain much of the water, we were told, finds its way through the house, by means of the passage, to the street outside.

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Some of these River Street houses, and perhaps all, are, I understand, shortly to be taken down to make room for a new street hereabouts, and this fact was urged as an excuse for their condition.

Distil House Row, which is entered from River Street, consists, as at the time of the 1886 inspection, of eleven small four-roomed cottages at the right hand side as one enters from River Street, and of two cottages, without thorough ventilation, at the end furthest from the entrance. The eleven cottages face an open unpaved yard, in which slops are disposed of down gullies there situated. The closets for the use of the inhabitants are placed at the one end of the yard, and partly under a high wall which faces the eleven cottages. These latter w.c.'s are cut off from the view of the cottages opposite by a wall erected in front of the closets. All the closets are now supplied with water, and water has been laid on for the use of the inhabitants, instead of the pump which was in use in 1886, but it has to be noted that certain of the houses were only so supplied very shortly prior to my inspection. Refuse is still deposited in holes in the ground, or in heaps in the yard, as at the time of the 1886 and 1888 inspections. I understand that some of the refuse is removed to a common ashpit situated in River Street, but the deposit of refuse in the open yard should be no longer allowed.

Red Lion Row Court is also entered from River Street. On the left-hand side on entering, some good cottages have been erected by the owner. In this court are some tenement houses in a dilapidated condition; at No. 12 the ceiling is falling down in the passage, and the yard adjoining the house is in great need of paving. At Nos. 15 and 16 new flushing apparatus has recently been put into the w.c.'s. At No. 14 was a closet entered from the scullery, and the arrangements are such that the w.c. must needs ventilate into the house. There is no light whatever in the w.c., and no adequate ventilation; and water had but quite recently been laid on. This case is apparently referred to on page 3 of the 1886 report, and further reference will be made to it when dealing with the sanitary administration of the Council.

Garden Court.—This Court, which has houses on either side of it, is entered by means of a narrow passage from River Street. The Court itself is divided up into small garden spaces in front of the houses, and running down the centre of the Court is a pathway which separates the gardens on the one side from those on the other. There are in this Court 21 cottages, 10 on the south and 11 on the north side, while the River Street Boundary is formed by common lodging-houses. The houses on the south side are built under the shadow of a high boundary wall, which abuts upon the premises in Thames Street, and the space between the wall and the backs of the houses is very much confined, the width varying from 4 feet 6 inches to 6 feet. This area, which is occupied by the w.c.'s and other domestic arrangements, is at times almost entirely covered in, in fact is most unwholesomely confined. There are no windows at the backs of the houses, and the staircases are very dark. The introduction of windows would be an improvement.

Behind the houses on the opposite side of the Court there is even less space than in those just described, and although there is no high retaining wall the confined condition of cramped backyards is deplorable. The conditions obtaining in the Court are very similar to those obtaining at the time of the visit of Dr. Airy and Mr. Taylor, but water has been laid on to the w.c.'s. There is still but one standpipe for the water supply of the cottages, and hence some of the inhabitants have to go a considerable distance for water.

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Keppel Row consists of several small dilapidated cottages facing a passage known as "Sun Passage," which is about eight feet in width, and which on the opposite side is bounded by a high wall. Behind, these cottages abut upon two sufficiently spacious yards which communicate with one another. In these yards are standpipes for the supply of the inhabitants, and also w.c.'s, which, although all supplied with water, are, in certain instances, in serious disrepair. The downfall pipes of the dwellings are in places fractured, and the rain water gullies are defective. The roofs of the wash-houses are, in a number of instances, dilapidated. The cottages consist partly of three-roomed dwellings (including a back scullery), and partly of four-roomed dwellings; but we were refused entrance at several of these places, and as to this refusal I shall have more to say. As to one of the houses into which we gained entry, the ceiling was falling down in the little back bedroom, and the room being uninhabitable, the boy (aged 14) who formerly slept there had now to sleep in his mother's room. The rain had come into the back room since the present tenants had occupied the house, and I see by reference to the 1886 report "that some of these back rooms are not occupied because of the damp." Dampness caused by a broken rain pipe was obvious inside the house.

We were informed that at another house in the row there was much overcrowding, and, by the number of children we saw in the act of entering, an air of probability was given to this statement. The Inspector of Nuisances was, however, refused admission to the house, and I gathered from him that he had been on more than one occasion thus treated.

Sydney Place.—Space behind houses extremely contracted. At No. 4 the passage, when the front door was shut, was absolutely dark, and progress could only be made by feeling one's way. In a small room at the back, without a fireplace, there was a dirty mattress on the floor, and a stream of water running from the small broken window along the floor to the mattress. There was no furniture whatever in the room, which was, nevertheless, used for human occupation.

Bachelor Place.—There are here a few wooden houses, some of which are closed. The w.c.'s connected with these houses are dilapidated and very far from weather-tight.

Queen's Square.—A small yard with houses in front of it. In one—a corner house—the ceiling was falling down in the back room on the ground floor and in the back bedroom; staircase and floor all dilapidated and general condition of house most unsatisfactory, ground floor below level of street, uncovered dilapidated ashpit in yard.

Acre Passage.—Here I found a dilapidated-looking dwelling consisting of two rooms on the ground floor which was below the level of the adjoining passage. Water comes in at the front door when it rains, and the rain came in upstairs until quite recently. The room on the ground floor was but 6 ft. 2 ins. high. Defective rainpipe coming through unventilated washhouse which opens off kitchen. In another house in the same passage there were two rooms on the ground floor, a kitchen and scullery opening into one another, and in the scullery was a w.c., which was not cut off from the remainder of the scullery. The rain had, for some time, been coming through the roof, which, however, has lately been repaired. No thorough ventilation whatever—staircase quite dark, floor in bedroom dilapidated, signs of recent damp all over bedroom ceiling; general condition of the premises very bad.

COMMON LODGING HOUSES.

Of the three common lodging houses which I visited, two were in such a condition as to show that no proper control had for a prolonged period been exercised with respect to them, nor were these places, in their then condition, suitable for the uses to which they were put. It is true that in 1863, and again in 1871, the Home Office confirmed certain byelaws with regard to the Windsor common lodging houses; but I had some difficulty in obtaining a copy of these byelaws, and when at last, at my special request, the Town Clerk sent a copy to me by the Sanitary Inspector, it was accompanied with a wish for its return, as it was the only copy the Town Clerk possessed. It would seem, indeed, from what I saw and heard, that these byelaws had for many years been disregarded, if, indeed, their existence had not been entirely forgotten.

For instance, the byelaws stipulate that the walls and ceilings of every room shall be well and sufficiently limewashed at least four times a year. But it was quite obvious that this provision had not been enforced, while the conditions as regards cobwebs, dust, and dilapidated plaster in more than one of the staircases and rooms showed that there had been great neglect as to ordinary cleanliness. Ventilation, too, was far from satisfactory, and the yards in connection with the houses required repaving. The Sanitary Inspector and the Medical Officer of Health were apparently unaware what was the amount of cubic space allowed to each inmate, until an opportunity had been afforded them of consulting the byelaws, and even then the Medical Officer of Health seemed content with the 250 cubic feet ordained in 1863.

The ticketing of the rooms had evidently been performed in a very slovenly manner, and in several instances certain numbers had been erased, or crossed out in pencil, and others substituted, while again in some rooms there were no tickets whatever. In fact, there was evidence of an entire want of proper control on the part of the Town Council. As an instance of this want of control I may relate the following:—

One of the byelaws states that—

> "The keeper of every common lodging house who shall permit or suffer persons of opposite sexes, except children under the age of six years, to sleep in the same room, unless such persons be man and wife, or such keeper shall, in the opinion of the Justices, have had reasonable cause for believing them to be man and wife, shall for every such offence forfeit and pay a sum not exceeding forty shillings."

I regret to have to state that, notwithstanding this byelaw, drawn up be it noted by the Town Council, it has been an almost nightly practice for two married couples to sleep together in adjoining beds—there being no partition, curtain, or any other device for screening one bed from another. I was so astonished at the revelation that I took some trouble to ascertain if there could be any error in the matter. I therefore cross-questioned the lodging-house keeper in the presence of a member of the Corporation, the Medical Officer of Health, the Surveyor, and the Inspector of Nuisances. There was, however, little need for cross-examination, the keeper admitting, with apparent pride, that he had three rooms for married couples, that each of these rooms contained two double beds, and that for the last 21 years at least the custom above-referred to had been nightly practised. He knew nothing as to byelaws: had never been told his methods were contrary to them; indeed, he was evidently genuinely surprised at any exception being taken to the practice.

The condition of the "Prince of Wales'" Common Lodging House was much more satisfactory than that of those to which the above remarks refer, but the tickets stipulating the number of beds in each room were whitewashed over.

SLAUGHTER-HOUSES.

Byelaws for the regulation of slaughter-houses were sanctioned in 1863, and byelaw No. 14 states that the occupier of every slaughter-house shall cause a copy of the byelaws to be affixed in some conspicuous place of such slaughter-house to the satisfaction of the Local Board and of their authorised officer. I was unable to ascertain that these byelaws had been enforced, nor were the butchers familiar with the byelaws. I suspect that, apart from the byelaws not being exhibited in the slaughter-houses, those which relate to the whitewashing of the premises twice yearly, and to the provision of tubs with tight and close-fitting covers have not been properly observed.

DAIRIES, COWSHEDS, AND MILKSHOPS.

Regulations under the Dairies, Cowsheds, and Milkshops Order of 1885 were made by the Windsor Town Council in 1887. These regulations, which make no specific provision as regards the amount of cubic space in cowsheds, had not been so fully brought to the notice of milkshop keepers within recent years as could have been wished. In certain instances the Inspector of Nuisances had been instrumental in bringing about very considerable improvements in the condition of milkshop premises, but in others, the circumstances under which the cleansing and the storing of the milkpans was carried out left very much to be desired, and customers would have not been reassured by a visit to these places.

I think a higher standard of sanitation should be adopted by the officers of the Town Council in dealing with places where a commodity so liable to contamination as milk is sold.

BAKEHOUSES.

I visited a considerable number of these, and in certain instances the statutory provision as to half-yearly whitewashing, as laid down by the Factory and Workshop Acts, has clearly not been complied with. In other instances sundry repairs were necessary.

BYELAWS.

I have already made with regard to the byelaws certain observations which point to the fact that the adoption of byelaws has not always been followed by their enforcement.

The byelaws in existence in Windsor are, as far as I have been able to determine, the following:—

1. Byelaws for the Regulation of Common Lodging Houses, 1863.
2. Additional byelaws for the Regulation of Common Lodging Houses, 1871.
3. Byelaws for the Regulation of Slaughter-Houses, 1863.
4. Byelaws with regard to the Cleansing of Footpaths and Pavements, the Removal of Refuse from Premises, and the Cleansing of Privies, Ashpits, and Cesspools, 1863.
5. Byelaws with respect to Nuisances in connection with the Removal of Fœcal or Offensive or Noxious Matters or Liquid, 1896.
6. Byelaws with respect to New Streets and Buildings, 1887.
7. Byelaws with respect to Nuisances, 1890.
8. Byelaws with respect to the Prohibition of the use of Buildings in the Borough of New Windsor, unfit for habitation, for such habitation, 1890.
9. Byelaws with respect to New Buildings, 1890.
10. Regulations under the Dairies, Cowsheds, and Milkshops Order of 1885, adopted in 1887.

It will be apparent from the dates at which certain of these Byelaws were made, that such Byelaws are now considerably behind the times in their requirements, and the supply of copies of certain series appears to have run out. The provisions of such Byelaws have been almost forgotten, even by those whose business it is to enforce them.

The older Byelaws should certainly be at once revised on the basis of the Model Series of the Local Government Board, and, when printed, their requirements should be notified to all concerned, and care should be taken to see that they are carried out.

I would also suggest that the Town Council should take into consideration the question of adopting Byelaws under the Public Health Act Amendment Act, 1890, Part III, Section 23 of which provides that

> (1.) "Section 157 of the Public Health Act, 1875 shall be extended so as to empower every urban authority to make Byelaws with respect to the following matters:—
>
> (*a.*) "The keeping of water-closets supplied with sufficient water for flushing."
>
> (*b.*) "The structure of floors, hearths, and staircases, and the height of rooms intended to be used for human habitation."
>
> (*c.*) "The paving of yards and open spaces in connection with dwelling houses; and
>
> The provision in connection with the laying out of new streets, of secondary means of access where necessary for the purpose of the removal of house refuse and other matters."
>
> (2.) "Any Byelaws under that section as above extended with regard to the drainage of buildings, and to water-closets, earth-closets, privies, ashpits, and cesspools, in connection with buildings, and the keeping

of water-closets supplied with sufficient water for flushing, may be made so as to affect buildings erected before the times mentioned in this said section (*i.e.*, section 157)."

. . . .

(4.) "Every local authority may make Byelaws to prevent buildings which have been erected in accordance with Byelaws made under the Public Health Acts from being altered in such a way that if at first so constructed they would have contravened the Byelaws."

The paving of yards and open spaces is one of the most necessary reforms wanted at Windsor, and the Medical Officer of Health is, I believe, fully alive to it. The adoption of the Byelaws I suggest would do a great deal towards bringing about improvement in this direction, notwithstanding the fact that such Byelaws are not applicable to buildings erected prior to the time mentioned in Section 157, Public Health Act, 1875. In Windsor, however, a large number of the existing houses would probably be amenable to the Byelaws referred to.

ADOPTIVE ACTS.

The Infectious Disease (Notification) Act was adopted in the spring of 1891, as also was the Infectious Disease (Prevention) Act. Parts II., III., and V. of the Public Health Acts Amendment Act were adopted early in 1892.

MR. STONEHAM'S COMPLAINT.

It will be convenient if the subject of this complaint be dealt with here:—

Mr. Stoneham, in a letter already referred to, complained that a certain report of the Medical Officer of Health had been partially suppressed, and that it was only by accident that that part of the report which dealt with the insanitary condition of Victoria Cottages became public. Mr. Stoneham protested against the "suppression," and asked that the matter should be enquired into.

I have been at some trouble to ascertain the exact state of affairs as regards this matter, and in relation thereto I have conferred with several prominent members of the Town Council, with the officials of the Council, and with the reporter whose duty it was to copy the reports on the specific occasion to which Mr. Stoneham's communication relates. I have also examined the Medical Officer of Health's report book, and the minute book of the Sanitary Committee.

It has apparently been the practice, since 1883, for the Medical Officer of Health to make monthly reports to the Sanitary Committee, who, in the first instance, deal with the subject matter of such reports. The exact method of report by the Medical Officer of Health, has, however, varied somewhat from time to time. For a certain period it was his custom to make two separate reports each month—one in his report book, the other on a sheet of paper. The first of these reports was for the exclusive use of the Sanitary Committee, the latter apparently for the use of the Council and the Press. The report on a separate sheet of paper was, however, subsequently discontinued, and instead, the Medical Officer of Health made usually two separate reports in the report book—one for the Committee, which dealt with matters which he presumably did not deem it desirable should be made public; the other relating to statistics and which he apparently saw no objection to making public. At times, however, he made but one report, in which a space would be left at a certain point serving to indicate what might conveniently be published, and what had better not be made public. The whole of these two reports went, it would seem, before the Committee, and at times this Committee indicated what part of such report or reports was to go to the Council. In other instances there is no reference whatever as to what was to be done with either the whole or parts of the Medical Officer of Health's reports.

In the instance to which Mr. Stoneham's allegation has reference there was but one report, and it was not divided into parts. In the minutes of the Sanitary Committee, dealing with this report, there is no instruction as to what part of it should be sent to the press.

It would appear, as far as I have been able to ascertain, that where no indication or separation of his reports into two parts has been made by the Medical Officer of Health, and where, furthermore, the minutes of the Sanitary Committee contain no instructions as to the dealing with such report, suggestions to the Press reporters as to what part they were to copy, or what part they were to leave uncopied, must have been made in the Town Clerk's office. In relation to this matter, indeed, I may add that in an interview which I had with Councillor Sir John Soundy and with Alderman Westlake (Chairman of the Sanitary Committee), Mr. Westlake informed me that it has in the past been absolutely at the discretion of the Town Clerk as to what parts of the Medical Officer of Health's reports to the Committee should subsequently be laid before the Council. No fresh arrangement as to this had been made at the time of the interview in question, but Sir John Soundy informed me that there was a very strong feeling in the Council that the old arrangement should not continue. In one of my interviews with the Town Clerk I pointed out to him what I had been told by Mr. Westlake as to the practice, and, although the Town Clerk did not accept Mr. Westlake's statement in its entirety, I have no alternative but to accept it, seeing the source from which it came, and in my view the evidence supports this statement.

In the specific instances raised by Mr. Stoneham, the press reporter called, in accordance with his usual custom (the reporter of each of the two local papers taking turns as to this duty), at the Town Clerk's office, and asked for the reports down in the agenda for the next Council meeting. The Town Clerk was absent, as were also the chief and second clerks, and in their absence the office boy shewed the reporter the Medical

Officer of Health's report book. From this book the reporter copied the whole of the report, there being no division or other indication that part of the report was not for publication. One copy of the report the reporter sent to his colleague on the other local paper. At the following meeting of the Town Council a portion only of the Medical Officer of Health's report was read, that part relating to the condition of Victoria Cottages being left unread. In the next issue of the local newspaper the whole of the report appeared.

That this discrepancy gave rise to considerable criticism and surprise among the members of the Town Council can easily be imagined.

SANITARY ADMINISTRATION ON THE PART OF THE TOWN COUNCIL, AND OF THEIR OFFICERS.

The foregoing portion of this report will probably have convinced the Board that sanitary administration in Windsor is not all that it should be. It would appear, as far as I have been able to gather from personal observation, and from conferences I have had with the members and officials of the Town Council, that there is a want of what may be termed "backbone" in the proceedings of the Sanitary Authority. There has been, I think, too much action of an apologetic sort, and too much non-effectual and more or less informal letter writing; there has been, in a word, indecision in dealing with the matters under consideration.

As this inquiry has been brought about mainly through the action of Mr. Stoneham in reference to Victoria Cottages, I have asked the Inspector of Nuisances to extract for me from his report book the several reports which he has made in reference to these cottages, and an account of the action taken in consequence of his reports. These extracts, which will be found below, should, I think, be studied by all those desiring to understand the matter aright. They show what steps have been taken since 1895, and how little action has on many occasions followed the Inspector's report. As to why practically no action was taken, and as to why all this procrastination was practised, I am not able to say. In this connection, I would especially commend to the members of the Town Council a perusal of the Inspector of Nuisances' Reports (not here extracted) to the Sanitary Committee as to the supply to certain of Victoria Cottages of water for closet flushing purposes. These reports illustrate in striking fashion the want of decisive action to which I have been adverting.

For the purposes of this report I cite an instance other than Victoria Cottages of procrastination in requiring water supply to closets. After inspecting certain houses in Red Lion Court, in which I found the water had but a very short time previously been laid on to the closets, I referred to Dr. Airy and Mr. Taylor's 1887 Report, and ascertained that these identical houses are also there referred to as being without proper flushing arrangements. The Inspector of Nuisances has, at my request, furnished me with extracts from his reports, which illustrate how long the Town Council take to remedy nuisances of this kind.

On the Sanitary Condition and Character of the Administration of the Borough of Windsor; by Dr. Bulstrode.

"EXTRACTS FROM SPECIAL REPORT TO A MEETING OF THE SANITARY "AUTHORITY IN COMMITTEE.

"*Victoria Cottages.*

"August 1895.—Reported to the Health Committee, 22 of the cottages required the roofs repaired, and 37 others required internal cleansing.

"Copy of this Report to be sent to the owner. The Inspector further reported, in his opinion, the drains to a number of the water-closets were more or less defective, and recommended the drains should be opened and the smoke test applied.

"No instructions given.

"June 1897.—Inspector reported to the Health Committee in detail on defects which required amendment in 44 of these cottages.

"No instructions given.

"August 1898.—Inspector reported to the Health Committee that, instructed by the Medical officer of Health, he had made a re-inspection of these cottages. Very little had been done to improve their condition; practically in the same condition as when inspected in 1897.

"A detailed list of defects sent to owner's agent.

"November 1898.—Inspector reported to the Health Committee that the repairs to these cottages are not being got on with; many of the wash-houses are in a ruinous condition.

"No instructions given.

"December 1898.—Inspector reported to the Health Committee he had inspected 10 of these cottages on complaints of leaky roofs.

"No instructions given.

"March 1899.—Inspector reported to the Health Committee he had again made an inspection of these cottages, and submitted a list of 32 of them which were, he stated, in very bad condition.

"Town Clerk to write.

"April 1899.—Inspector reported to the Health Committee he had again visited the 32 cottages reported on at the previous meeting. Nothing had been done to improve them.

"June 1899.—Inspector reported to the Health Committee, he had, owing to complaints, again inspected these cottages and furnished the Medical Officer of Health with a list of those which were in the most dilapidated condition—27 in number.

"The Medical Officer of Health and the Borough Surveyor subsequently made an inspection, and reported to the Health Committee, and subsequently to the Sanitary Authority, as to the condition of these 27 cottages, and statutory notices were served on the owner by the Town Clerk, Mr. Lovegrove.

"December 1899.—At a special meeting of the Sanitary Authority, the Inspector reported on 60 of these cottages, and laid information that they were in such a condition as to be a nuisance and unhealthy.

'December 21 1899.—The Inspector and Medical Officer of Health now making a re-inspection.

APP. A, No. 8.

On the Sanitary Condition and Character of the Administration of the Borough of Windsor; by Dr. Bulstrode.

"*Red Lion Row.*—Below are the dates when statutory notices were served on the owners to provide a supply of water and flushing apparatus to the water-closets of Nos. 14, 15, and 16.

"These dates also include reports as to non-compliance.

1894	April 6th.
"	May 4th.
"	August 3rd.
1896	June 5th.
"	September 7th.
1898	February 3rd.
"	March 4th.
"	September 9th.
"	August 4th.

"A supply of water and apparatus provided."

It must not, however, be supposed that no sanitary progress has within recent years been made in Windsor, or that the supply of water for flushing closets is the only reform which has been brought about. On the contrary, the two tables in the Appendix, one furnished to me by the Medical Officer of Health, the other by the Inspector of Nuisances, will show that during the past decade a very considerable amount of routine work has been performed.

The Medical Officer of Health, Dr. Edward Casey, M.D. London, was elected to his present post in 1882. The Town Council does not receive part repayment of his salary from the county funds, but having been appointed subsequently to 1881 he is amenable to the regulations of the Board's General Order as to the duties of Medical Officers of Health.

Dr. Casey is a gentleman of considerable ability, and has been instrumental during his long term of office in bringing about several sanitary reforms in Windsor. Unfortunately Dr. Casey was taken ill shortly after the commencement of my inspection, and hence I had not the opportunity of gaining so full an insight into his methods and views as I could have wished. I have, however, read all Dr. Casey's reports, and as he also accompanied me during the early part of my inspection, I have been able to gather something as to his work.

Dr. Casey seemed to me to be somewhat too apologetic in his general attitude, and I was especially struck with this in relation to the condition of certain common lodging houses. True, as regards these, Dr. Casey disclaimed any responsibility in their control, but it is his duty to ascertain by inspection the conditions likely to be prejudicial to health in his district, and this being so he should, I think, have advised the Town Council that 250 cubic feet per head in common lodging houses cannot now be regarded as adequate. It is far from my intention to detract from the valuable work done by Dr. Casey during many years in Windsor, but it seems to me that in the interests of the public health, and for the sake of the fair name of Windsor, a higher standard might well now be adopted.

APP. A, No. 8.

On the Sanitary Condition and Character of the Administration of the Borough of Windsor; by Dr. Bulstrode.

The Inspector of Nuisances, Mr. S. W. Mellows (Associate of the Sanitary Institute), was appointed early in 1888, and receives a salary of £150 per annum. Mr. Mellows was also for some years Water Inspector for the whole water area with a population of some 20,000.

Of Mr. Mellows I saw much during my inspection, and I was favourably impressed with his method of work. He was well received at the houses we visited, and proceeded in a tactful fashion. Mr. Mellows has in the past evidently done good work. It is clear from the papers which are at my disposal that this officer has been well thought of, more particularly in the early part of his work in Windsor, and his Report Book amply illustrates that he takes considerable interest in his work. I fear, however, that in recent years he has for some reason or other become disheartened, and that hence he may not have given to his work that zeal and detailed attention which he apparently gave in earlier years. This has been, I think, particularly the case in reference to such matters as the common lodging houses, and the slaughter-houses, and also as to the sanitary condition of some of the poorer property. I noted, too, that in one instance in which during my inspection Mr. Mellows was refused entry he did not contemplate carrying the matter further, an omission which, in the case in question, was likely to impair his position and influence.

Mr. Mellows has not kept himself sufficiently in touch with the regulations and byelaws made by the Town Council, which it is part of their statutory duty to carry out. He has apparently, in some instances, almost forgotten the existence of such regulations, and it does not appear that adequate supervision has been exercised over the matters which they were framed to control. But in part extenuation of these omissions, reference should be made to the notes supplied by him to me in relation to procedure in reference to Victoria Cottages and sundry cottages in Red Lion Row. There is wanting at Windsor the initiating and guiding force necessary for vigorous administration.

I feel sure that there are many members of the Windsor Town Council who will be considerably surprised at the manner in which the sanitary administration of the borough, in certain instances, has in the past been carried on, and they will doubtless look for some better method of procedure in the future. It seems to me that the officials of the Corporation, more especially the Medical Officer of Health and the Inspector of Nuisances, should be more directly in touch both with one another and with the Health Committee, and that the Chairman should, at each meeting, ascertain from the officials responsible what action has been taken and what results have been obtained in reference to matters which were reported on at the preceding meeting. That this co-operation does not exist may be gathered from the manner in which certain complaints have been allowed to lapse, and by the fact that the Medical Officer of Health seldom, apparently, attends the meetings of the Health Committee.

The members of the Health Committee are certainly not free from blame in the matter, and they should take into serious consideration the question as to whether in the past an unfair amount of responsibility and discretionary power has not been allowed to devolve upon the Town Clerk through the omission on the part of the Sanitary Committee to deal definitely with the reports of the officials.

POSTSCRIPT.

Since completing this Report, I have been requested by the Town Council to add as an Addendum a Memorandum, prepared by the Corporation, dealing with the sanitary condition of Windsor. It will be there noted that many of the criticisms in my Report have been anticipated and already acted upon, and it affords me pleasure to place the facts on record by publishing the Memorandum(*See* Addendum No. 4).

ADDENDUM No. 1.

ANALYSES OF WATER FROM MAINS OF THE WINDSOR CORPORATION WATERWORKS.

Analysis of a sample of Water taken from the Main on Castle Hill, Windsor, February 17th, 1896.

The water was bright and clear and without odour when warmed.

Constituents per gallon.

Nitrogen as ammonia (free and combined)	0·000	grains.
Nitrogen as organic matter	0·004	"
Nitrogen as nitrates	0·066	,,
Oxygen required to oxydise the organic matter present	0·031	,,
Total solid matters	25·61	,,
Calcium oxide (existing as carbonate and sulphate)	10·51	,,
Magnesium oxide ,, ,, ,,	0·42	,,
Alkalis (,, chlorides and nitrates)	1·57	,,
Sulphuric anhydride (existing as sulphates)	3·51	,,
Chlorine (existing as chlorides)	1·63	,,
Carbonic anhydride (existing as carbonates)	6·80	,,
Nitric ,, (,, nitrates)	0·25	,,
Silica	0·07	,,

The water when boiled for some time precipitated :—

Calcium carbonate (chalk)	14·86	grains per gallon.
Magnesium carbonate	0·48	,, ,, ,,

So that the constituents of the water were most probably combined as follows :—

Calcium carbonate (chalk)	14·86	grains per gallon.
Magnesium carbonate	0·48	,, ,, ,,
Calcium sulphate	5·32	,, ,, ,,
Magnesium sulphate	0·57	,, ,, ,,
Sodium chloride (common salt)	2·69	,, ,, ,,
Alkaline nitrates	0·40	,, ,, ,,
Siliceous matter	0·07	,, ,, ,,

The hardness of the water was 19·0 degrees, but this was reduced on boiling for 15 minutes to 4·0 degrees.

The water was of good quality for dietetic purposes, and comparatively free from pollution by animal matter.

(Signed) E. J. A. MIDWINTER, F.I.C., etc.,
Borough Analyst.

77, Croydon Road, Anerley, March 30th, 1896.

Samples of Water taken from the Windsor Mains on October 22nd, 1897.

The water was quite clear and entirely free from odour when warmed.

Nitrogen as ammonia	0·000	grains per gallon.
Nitrogen as organic matter	0·001	„ „
Nitrogen as nitrates	0·048	„ „
Oxygen required to oxydise the organic matter	0·031	„ „
Total solid matter	26·391	„ „
Chlorine or chlorides	1·562	„ „
Equal to sodium chloride	2·574	„ „
Hardness in total	19·2	degrees.
Hardness after boiling 15 minutes	4·1	„

The water is of very good quality; it has been efficiently filtered, and may be used for dietetic purposes with absolute security.

E. H. MIDWINTER,
Borough Analyst.

November 20th, 1897.

Specimen taken at noon from the Windsor Corporation Main in Eton College on 25th January, 1898, *in the presence of Mr. Alderman Brown, J.P.*

The water was clear and without odour when warmed.

Nitrogen as ammonia (free and combined)	0·000	grains per gallon.
Nitrogen as organic matter	0·001	„ „
Nitrogen as nitrates	0·0481	„ „
Chlorine as chlorides	1·562	„ „
Equal to sodium chloride	2·574	„ „
Oxygen required to oxydise organic matter	0·031	„ „
Total solid matter	26·391	„ „
Temporary hardness	19·2	degrees.
Permanent „	4·1	„

The water was of good quality, safe for dietetic purposes, and had been efficiently filtered.

E. H. MIDWINTER,
Borough Analyst.

Analysis of Water taken from the Mains of Windsor Corporation Waterworks in Victoria Street, Windsor, on May 10th, 1898, *at* 12.30 *p.m.*

Nitrogen as ammonia (free and combined)	0·000	grains per gallon.
Nitrogen as organic matter	0·002	„ „
Nitrogen as nitrates	0·041	„ „
Oxygen required to oxydise the organic matter	0·022	„ „
Total solid matters	25·561	„ „
Chlorine as chlorides	1·42	„ „
Equal to sodium chlorides	2·34	„ „
Hardness temporary	19·0	degrees.
„ permanent	0·8	„

The water was bright and clear and had no odour when slightly warmed. The water is of good quality and efficiently filtered; there is some improvement since my last analysis was made.

E. H. MIDWINTER,
Borough Analyst.

June 21st, 1898.

APP. A, No. 8.

On the Sanitary Condition and Character of the Administration of the Borough of Windsor; by Dr. Bulstrode.

Analysis of a sample of Water taken from the Main near the Wesleyan Chapel, New Road, Windsor, in the presence of Mr. Councillor Webber, 11 *a.m.*, *October*, 1898.

The water was bright and clear and without odour.

Nitrogen as ammonia (free and combined) ...	0·000	grains per gallon.
Nitrogen as organic matter	0·002	„ „
Nitrogen as nitrates	0·045	„ „
Oxygen required to oxydise organic matter ...	0·036	„ „
Chlorine as chlorides	1·562	„ „
Equal to sodium chloride	2·574	„ „
Total solid matters	25·097	„ „
Hardness temporary	19·0	degrees.
„ permanent	4·0	„

The water was of good quality and had undergone efficient filtration.

E. H. MIDWINTER,
Borough Analyst.

November 12th, 1898.

Analysis of a sample of Water from the Windsor Main in Park Street, taken in the presence of Alderman Brown, J.P., at 11.30 *a.m.*, *December 2nd*, 1899.

The water was very slightly turbid, the turbidity consisting of earthy matter. It was free from odour when warmed.

Constituents per Gallon.

Nitrogen as ammonia (free and combined)	0·000	grains.
Nitrogen as organic matter	0·0025	„
Nitrogen as nitrites	0·000	„
Nitrogen as nitrates	0.041	„
Oxygen required to oxydise organic matter	0·034	„
Chlorine as chlorides	1·746	„
Equal to sodium chloride (common salt)	3·042	„
Total solid matters...	26·01	„
Temporary hardness	19·4	degrees.
Permanent „	4·0	„

The water is satisfactory, free from pollution, and of good quality.

E. H. MIDWINTER,
Borough Analyst.

December 29th, 1899.

ADDENDUM No. 2.

NOTES FROM MEDICAL OFFICER OF HEALTH'S REPORT BOOK, FURNISHED BY DR. CASEY.

Jan. '90	40, South Place. Nuisance, such as to render unfit (report to Committee).
Sept. '90 May '90	Recommendation to H.C. that 32, South Place be demolished to allow space for construction of wash-house.
Nov. '90	4, Church Street. Unfit for habitation (H.W.C. Act).
April '91	Houses in Queen's Square. Obstructive (H.W.C. Act).
June '91	17, 19, Oxford Road. Unfit for habitation (H.W.C. Act).
March '92	1, 2, 3, Wellington Square. Injurious to health by reason of want of through ventilation.
Dec. '93	33, 35, 37, Oxford Road. Unfit for habitation (H.W.C. Act).
Aug. '94	1, 2, 3, Wellington Square. Repetition of recommendation, March '92.
,,	5, Wellington Square. Unfit for habitation ; nuisance.
,,	1, Garden Court. Unfit for habitation.
,,	67, 69, Oxford Road. Unfit for habitation.
Dec. '95	22, Park Street. Nuisance, so as to be unfit.
Jan. '96	Harris's Slaughter-house. Unfit for use.
,,	Parle's Lodging-house. Unfit for habitation.
July '96	Recommended paving of Waterloo Square (P.H. Act, sec. 150).
Dec. '96	Voluntary notification of measles. Recommendation adopted.
Aug. '97	Morgan's Cow-sheds. Unfit for use.
Feb. '98	Three houses in Batchelor Place. Unfit for habitation (H.W.C. Act).
April '98	1, 2, 5, 6, Distil. H. R. Unfit for habitation (? H.W.C. Act).
,,	4, 7, 8, Distil. H. R. Nuisances, such as to unfit.
Nov. '98	17, Keppel Road. Unfit for habitation (H.W.C. Act).
Dec. '98	4, 5, 8, 19, 20, 21, Garden Court. Nuisances, and condemnation threatened.
Jan. '99	1, Waterloo Square. Nuisance, and condemnation threatened.
April '99	Strong report on 55, 67, 69, 75, 76, 77, 78, Victoria Cottages.
June '99	Twenty-one houses, Victoria Cottages. Nuisances; and nine of them so as to be unfit for habitation.
Oct. '99	2, 3, Garden Court. Nuisances.
,,	21, Garden Court. Nuisance, and unfit.
Nov. '99	6, 8, Wellington Square. Unfit for habitation (H.W.C. Act).
,,	5, Wellington Square; seven houses in Sydney Place and six houses in Keppel Road. Nuisances.

Three houses reported obstructive, and fourteen unfit for habitation (H.W.C. Act); also twenty-seven others as nuisances, so as to be unfit (P.H. Act).

APP. A, No. 3.

On the Sanitary Condition and Character of the Administration of the Borough of Windsor; by Dr. Bulstrode.

ADDENDUM No. 3.

NOTES FURNISHED BY MR. MELLOWS, THE INSPECTOR OF NUISANCES.

Year.	House to House Inspection and Special Visitations.	Informations. Reports on Nuisances to Sanitary Authority.	Statutory Notices served.	New Drains provided.	Drains reconstructed or repaired and ventilated.	Inlets to Drains properly trapped.	New W.C.'s provided.	W.C.'s provided with Water and Flushing Apparatus.	Wells closed; Pumps abolished.	Overcrowding abated.	Damp Houses improved.	House Ventilation improved.	Houses closed or demolished.	Houses cleansed and Room Ceilings whitened.	Other Defects and Nuisances remedied.
1888 ...	892	21	17	9	26	82	1	4	3	8	—	—	—	54	—
1889 ...	1,199	5	1	13	23	122	2	3	1	8	12	10	—	36	—
1890 ...	1,292	14	13	6	18	26	13	19	4	6	10	—	Closed, 7. Demolished, 6.	51	—
1891 ...	1,362	9	5	15	21	16	8	12	4	4	5	25	3	36	—
1892 ...	1,272	9	9	21	29	30	9	15	2	7	10	10	4	42	—
1893 ...	986	65	61	11	39	23	2	74	1	3	7	7	3	92	—
1894 ...	1,642	11	319	11	34	21	10	371	11	2	9	—	—	80	—
1895 ...	1,982	8	79	26	36	25	3	13	—	6	13	6	—	64	—
1896 ...	1,254	Stat., 125 Inf., 15	125	12	71	19	—	84	—	6	14	—	Houses made habitable, 5.	41	—
1897 ...	1,258	21	15	13	22	15	—	24	2	8	14	16	—	52	—
1898 ...	1,468	82	72	23	15	31	—	65	3	11	25	—	Closed, 8. Reported, 13.	132	—

S. W. MELLOWS, *Inspector of Nuisances.*

APP. A, No. 8

On the Sanitary Condition and Character of the Administration of the Borough of Windsor; by Dr. Bulstrode.

ADDENDUM No. 4.

MEMORANDUM of REMARKS which the WINDSOR CORPORATION hope may be APPENDED to DR. BULSTRODE'S REPORT upon the SANITARY CONDITION of the TOWN.

After Dr. Bulstrode's visit a Special Meeting was held to consider the Sanitary Condition of the Small Houses.

At the meeting it was resolved :—" That a house-to-house inspection be made of all the smaller properties in the town by the Medical Officer of Health and the Sanitary Inspector."

The result was that the Reports of those officers were presented to the Town Council, who thereupon decided to take legal proceedings in 60 cases.

Two test cases were heard before the magistrates, who, after inspecting the houses (Nos. 57 and 24, Victoria Cottages), dismissed both cases *with costs against the Corporation*, and at the suggestion of the Bench the remaining cases were adjourned for three months.

River Street.—The byelaws relating to Lodging Houses have been brought to the attention of the keepers, and proceedings taken to obtain a closing order. They were then put into a sanitary state and so reported by the Medical Officer of Health and Sanitary Inspector. Regular inspection is now made to see the byelaws are enforced. In the case of property owned by Mrs. Sanders, the Council have given notice to treat for its purchase, and the houses, when acquired, will then be pulled down and street improvements effected.

No. 14, Red Lion Row has been renovated.

Keppel Row.—As to these houses, proceedings were pending at the time of the Inspector's visit, and have been carried to a successful issue.

Acre Passage (Hibbert's Alley).—The three houses complained of have been closed. Sanitary improvements to the remaining dwellings in this passage are now in progress.

Sydney Place.—The area adjoining the forge has been properly paved and drained. The nuisance at No. 4 has been abated.

Love Lane.—A representation was made by the Medical Officer of Health under the Working Classes Act, as to two of the worst houses in this street, and they are shortly to be demolished.

Copies of the Byelaws have been re-issued to the various trades affected.

With a view to insuring greater promptitude and efficiency in procedure for the abatement of nuisances, the Inspector of Nuisances has been instructed to act more immediately under the direction of the Medical Officer of Health, and to make his reports of nuisances to him, as well as to the Health Committee as heretofore. The Medical Officer of Health has been invited to attend the meetings of the Health and Drainage Committee.

Sanitary improvements have been carried out in many other houses in the town (than those before mentioned), which will be seen on reference to the Report Books forwarded herewith.

It has been resolved to forthwith erect a Refuse Destructor, and instructions have been given for application to be made to the Local Government Board for borrowing the necessary capital.

Orders have been given for samples of water from the Borough Works to be taken, under the direction of the Medical Officer of Health, every three months, and sent for analysis, and the Analyst's Report to be sent to him.

The pumps at the Sewage Works, Old Windsor, are now working night and day.

No. 9.

REPORT upon INSPECTION of the GATHERING GROUNDS and WATERWORKS of the CORPORATION of BOLTON; by Dr. G. S. BUCHANAN and Mr. R. H. BICKNELL.

APP. A, No. 9.

On Inspection of Bolton Waterworks and Gathering Grounds; by Dr. Buchanan and Mr. Bicknell.

In February, 1899, the Board received application from the Bolton Corporation for sanction to loan of £1,600 for the purchase by them of land comprised in the Entwistle gathering ground of their waterworks. At sundry dates since 1895 similar applications for sanction to loans for the purchase of portions of the Entwistle gathering ground had been made to, and had received the assent of, the Board. But, in considering a new application to sanction loan in connection with the waterworks of Bolton, the Board had regard to the following circumstances:—

(1.) In 1898, inquiry was held at Bolton by Mr. Willcocks as to a proposed loan of £10,500 for waterworks purposes, some £3,000 of which were required to defray the cost of a new main to Middle Hulton which had just been constructed. This main, a continuation of others laid at earlier date, served a portion of the area supplied by the Bolton Waterworks which stands at high level. Water conveyed through these high-level mains, the Board learnt, was derived solely from the "Dingle" gathering ground.

It appeared, from memoranda furnished to the Board by Dr. Houston after visit to the Bolton gathering grounds in 1896, that water obtained from Dingle gathering ground, which is a peaty moorland, acted decidedly upon lead. The Bolton Town Council, however, had not, in 1898, proposed any scheme for filtering their high-service water, or for otherwise treating it so as to counteract its lead-dissolving properties. In these circumstances the Board, after Mr. Willcocks' inquiry, informed the Town Council that they would require, as a condition precedent to the sanction of loan for the Middle Hulton main, that a proper scheme of filtration should be submitted to them, together with a formal undertaking by the Town Council to continuously deal with the high-level water by such means as might be adopted with the Board's approval. The Corporation have since resolved to construct filters for this high-service supply, and have now applied to the Board for sanction to loan for the purpose.

(2.) There are three gathering grounds of the Bolton Waterworks, respectively named Entwistle, Dingle, and Heaton. At Entwistle, as has been said, the Corporation had, with the assent of the Board, in accordance with Arts. IV. and V. of the Local Government Board Provisional Order Confirmation (No. 15) Act, 1894, purchased sundry lands comprised in the gathering area, presumably with the praiseworthy object of preventing water pollution thereon. Apart from the fact of these purchases, however—which related to one only out of the three gathering areas—the Board had before them no information, from reports of the Medical Officer of Health or otherwise, as to the precautions which had of late years, and on all three gathering grounds, been taken to guard against contamination of the sources of the Bolton water supply.

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(3.) Knowledge upon these points was the more to be desired, seeing that the Bolton Corporation supply water not only to the Borough of Bolton, but also to several Urban and to portions of certain Rural Districts in the neighbourhood of Bolton.

In these circumstances the Board instructed us, when at Bolton to hold formal inquiry as to the proposed purchase at Entwistle, to inspect the several gathering grounds and waterworks. This we did upon April 14th and on subsequent days.

GENERAL DESCRIPTION.

Water from Bolton Waterworks is distributed within a "Water Supply Area" which comprises the Borough, four whole Urban Districts, and parts of two other Urban Districts and of two Rural Districts. In addition, three Urban Districts outside the boundaries of the "water supply area" are supplied by meter.

Within Boundaries of Water Supply Area.

——	Present Population, as estimated by the Bolton Medical Officer of Health.	Acreage.
Bolton County Borough (as extended 1898)	160,000	15,283
Turton Urban District	12,747	17,522
Farnworth Urban District	25,000	1,502
Kearsley Urban District	9,250	996
Little Hulton Urban District	7,178	1,706
Part of Barton-on-Irwell Rural District (Clifton) ...	(?)33,075	1,193
" Worsley Urban District		1,308
" Bury Rural District (Ainsworth)		2,365
" West Houghton Urban District (Over Hulton)		
	247,250	41,875

Out of the estimated present total population of some 247,000 comprised in this water supply area, nearly the whole derive their water from the Bolton Waterworks.

The estimated total quantity of water daily consumed within the water supply area is reckoned at 5,831,000 gallons. The daily consumption per head is computed at 17 gallons for domestic purposes, and 6½ gallons for trade purposes; total 23½ gallons. In Bolton, increase in the number of water-closets of recent years has involved a higher water consumption per head than was formerly the case. The increase has, however, been but slight, as the annual total of new water-closets has in the last few years been much smaller than the annual total of new slop water-closets.

Outside the Water Supply Area and supplied by Meter.

—	Estimated Present Population.	Acreage.
Rest of West Houghton Urban District ... ... Atherton Urban District ... ... Aspull Urban District	24,070	6,246

In these three districts the water consumption per head cannot readily be reckoned, as the proportion of their population served by the Bolton Waterworks has not been ascertained. For 1898 the total quantity supplied by meter is estimated at 322,000 gallons a day. This added to the daily consumption within the water supply area gives an estimated total supply derived from the Bolton works of 6,153,000 gallons per day.

Sources of Supply and Distribution.

All three gathering grounds are comprised within the "water supply area." From the centre of Bolton, Entwistle gathering ground (2,118) acres) is about 6 miles to the north; Heaton gathering ground (523 acres), 3 miles to the west; and Dingle gathering ground (600 acres), about 4 miles north-west.

Entwistle and the greater part of Dingle are in Turton Urban District. Heaton has, since the extension of the borough in 1898, been included within the boundaries of Bolton.

There are the following reservoirs :—

—	Capacity in Gallons.	Top Water Level: Height above O.D.
Entwistle system :—		
Entwistle reservoir	625,000,000	690·35
Sweetloves reservoir	90,000,000	517·0
Dingle system :—		
Springs reservoir	134,000,000	757·56
Dingle reservoir	79,000,000	717·41
Heaton system		
High Rid reservoir	130,000,000	578·50
Heaton reservoir	500,000	517·0

There are two sets of filters :—

Sweetloves filters: total area, 10,000 square yards; height, 572 feet above O.D.

Markland Hill filters: total area, 3,658 square yards; height, 521 feet above O.D.

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Water collected on the *Entwistle* gathering ground (estimated to average about 4 million gallons a day) passes to Entwistle reservoir, and thence by way of a tunnel called "Egerton Tunnel" to filter beds at Sweetloves, two miles north of Bolton.

On the *Dingle* system nearly all the water collected on the gathering ground passes to Springs reservoir, and thence into Dingle reservoir, which adjoins Springs at a lower level. Dingle reservoir water passes (1) about one million gallons a day, by gravitation in stone culvert, to Sweetloves filter beds, and (2) about 260,000 gallons per diem without filtration into a high-level main, serving an area comprising the higher parts of Halliwell, Chorley, Heaton, Markland Hill, Middle and Over Hulton. In all, the population served by this high-level main is now about 15,000. Prior to the extension of this main in 1898 it was about 10,000.

On the *Heaton* system, water from the higher portion of Heaton gathering ground is received into High Rid reservoir, whence it passes by gravitation to filters at Markland Hill. Water from the lower portion is collected by a catch-water culvert, which leads to the same filters. The average daily supply obtained from Heaton is reckoned at about one million gallons.

Filtered water from Markland Hill is received in the Heaton (service) reservoir. There is an 18-inch main from Sweetloves filter works to Heaton reservoir, and commonly the water from the Heaton gathering ground received into this reservoir is supplemented by water sent down from Sweetloves.

Mains from Heaton service reservoir and from Sweetloves filter works unite at several points within the borough. At Sweetloves, at a lower level than the filters, is Sweetloves reservoir (90 million gallons capacity). This is a balancing reservoir, and forms the terminal of the mains on the Sweetloves system.

GATHERING GROUNDS.

ENTWISTLE GATHERING GROUND:—Area, about 2,118 acres; average annual rainfall (for 31 years ending 1898), 53·04 inches.

Physical and Geological Conditions:—Entwistle reservoir, which receives all water derived from this gathering ground, is fed partly by a few small streams which enter along its margin, but mainly by Cadshaw Brook, the chief stream of the valley above the reservoir to the east. The tops of the hills on each side of this Cadshaw Valley are for the most part heathy moorland. The slopes to Cadshaw Brook and its tributaries are fairly steep, and here and there are abrupt. As a rule they consist of pasture land, which in places has been under-drained.

Cadshaw Valley is formed by "Middle Coal Measures." There are several naturally formed sections along the valley, some showing shales of this geological series, others sandstone with or without bands of shale, others a compact coarse-grained "gritstone." The southern slopes above Entwistle reservoir, which are steep, are formed by Millstone Grit. The greater part of the gathering ground is covered in varying thicknesses by glacial drift, which here for the most part is a crumbly clay.

The upper waters of Cadshaw Brook, and one or two small streams which flow directly into Entwistle reservoir from the north, are peaty, but elsewhere on the gathering ground little peat is met with. There are springs on the hillsides, and a material part of the water received into Entwistle reservoir is no doubt spring water.

Houses on the Gathering Ground:—The number of persons living on Entwistle gathering area is estimated at 180. Their dwellings, 36 in number, are mostly small farmsteads, scattered about the hillsides. Along the Bolton to Darwen road, which crosses the gathering ground, are a few cottages and two public-houses.

The Corporation have now become the owners of some 1,735* out of the 2,118 acres estimated to be comprised in this watershed. The rents, we were informed, bring in to the Corporation about 3 per cent. on their purchase money.

Opportunities of Pollution of Water derived from Entwistle Gathering Ground:—(1.) From manure on the land.—At the date of our inspection, the pasture lands bordering Cadshaw Brook and its tributaries were heavily manured. Where, as is common, the slopes are fairly steep, a sharp shower can hardly fail to carry into the stream washings from manure thus deposited. The manure appeared to be wholly derived from the farms on the gathering ground. It is said that no town midden refuse is used.

(2.) From farm buildings and dwellings.—Upon certain of the farms on this gathering ground, particularly those in the upper part of Cadshaw Valley, a special form of "manure tank" has been provided by, or at the instance of, the Corporation. This is a stone-built structure on the hillside just below the farm buildings. Its upper part is an open manure midden, level with the farmyard; its lower part is a tank, with a capacity usually of about 3,000 gallons, which receives by a gully the drainage of the midden. The walls of the tank are said to be cemented inside. The tank is emptied either by means of a pump at the top—an arrangement preferred by the officials of the Corporation—or by a pipe at the bottom of the tank, so placed that a cart can be brought underneath its outlet. In several instances slop water from the dwelling, drainage from stables and cowbyres, and surface drainage of the farmyard are led to the tank. Where the Corporation have required farm buildings to be drained, they have generally caused arrangements of this sort to be provided.

Cleansing of these tanks is, at uncertain intervals, effected by occupiers, who as a rule have a cart which can be used to receive the tank contents. Matters carted from the tanks are "slopped" over the surface of the pasture fields. It did not appear that precautions were often taken by farmers in selecting land away from watercourses for the purpose; in some instances slopes alongside watercourses had evidently been chosen.

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* The Corporation have actually purchased 1,785 acres at Entwistle, of which about 50 acres lie outside the Entwistle watershed.

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On other farms, including several which have been the property of the Corporation for a year or more, no provision has been made for farmyard drainage. Here, as is also sometimes the case where manure tanks have been provided, slop water from the dwelling and drainage from cowbyre and stable are carried by a few feet of drain to the slope below the farm, and occasionally are there discharged in situations where a sharp rainfall could easily wash polluting matter into the stream below.

Privies at the farms are either built on to open ash middens or, what is more usual, they are provided with pails. Privy-middens or pails are emptied by the householders when they are considered to have become full. Usually their contents are dumped on ground near the dwelling; in several instances we saw contents of privy pails on the slope below the dwelling, placed dangerously in regard of a stream. In other instances contents of pails and middens are distributed over fields bordering the streams, along with farm manure.

The following are a few instances of opportunities of pollution of water on this gathering ground which we observed in course of our inspection:—

"*Brown Field*" *Farm.*—Privy pails emptied on steep slope between house and stream within 50 feet of the latter. Slop water from dwelling runs over the surface of the same slope.

"*Green Walls*" *Farm.*—Manure tank full and "backed up." Large pool of liquid manure drainage and slop water round house. This drainage along with liquid matter leaking through walls of tank, reached the side of a road, and passed thence to land falling sharply to a tributary streamlet of Cadshaw Brook.

"*Tewitt Hall*" *Farm.*—A drain carrying slop water from the dwelling into a small runnel which flows direct to reservoir.

"*Duckworth Arms*" *Public-house and Cottages.*—Open, uncovered, over-full privy-midden. Overflow on to steep grass slope, about 90 yards from brook below. Drain from a public urinal and slop water from dwellings run on to same slope. The soil of this slope is clay, and is under-drained to the stream.

"*Green's Arms*" *Public-house.*—Washings from over-full open privy pit, and overflow from a tank which receives slop water and drainage of stables, and drainage of public urinal, pass on to surface of land sloping sharply to a tributary of Cadshaw Brook, which tributary emerges from a culvert about 150 yards from and 50 feet below "Green's Arms."

"*Cush House*" *Farm.*—The slope between farm buildings and stream ends in a small cliff, the foot of which is about 20 yards from the stream. Rubbish from the farm-house shot over this cliff. Pools at foot of cliff, draining into stream, discoloured by overflow from a tank for manure and slop water at the farm, which trickles down the slope and over the cliff.

"*Top o' t' Brow*" *Farm.*—Tank and midden, of kind approved by Corporation, recently provided. Contents of tank emptied on steep grass slope (clay soil) within 100 yards of brook.

[We may add a note with regard to the *Isolation Hospital of the Borough of Darwen*, situated near Bull Hill, at a point where there is a saddle in the hills, the south slopes of which are in Entwistle watershed, while the north slopes form the head of a valley leading to Darwen. The eastern boundary of this hospital site is formed by the Bolton-to-Darwen road, which crosses the saddle. Sewage from the hospital buildings passes to a tank, the overflow of which is carried by a pipe to the foot of a small gravel pit on the site, about 20 yards from the high road. This gravel pit is also used as the general "tip" for refuse from the hospital. The tank overflow appears to soak away. From appearances at the date of our inspection it seemed that a portion of this soakage finds its way to a ditch along the eastern side of the high road. Such slight flow as was to be seen in this ditch opposite the hospital boundary was in the main northward, off the Entwistle watershed. But not wholly so; opposite the southern boundary of the hospital what little flow there was in this ditch appeared to be by open channel to a watercourse leading to Entwistle reservoir. This watercourse receives all the washings from the surface of the Bolton-to-Darwen road.]

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Entwistle Water in Respect of Lead-dissolving Properties:—On his visit to Entwistle watershed in March, 1896, in time of considerable storm, Dr. Houston found that Cadshaw Brook water near the reservoir was distinctly acid and capable of acting upon lead, whereas certain of its tributary streams were neutral and had no action on lead. The reservoir water, tested at various points, contained only doubtful traces of acid. Dr. Houston indicated as probable the explanation that Cadshaw Brook water is neutral under ordinary conditions of rainfall, and that when, as at the date of his visit, the water of this brook is acid, it mingles in the reservoir with a large volume of neutral water. Moreover, the clay and sand, which form the bed of the reservoir, and which cause much turbidity of the reservoir water during heavy rainfall, probably possess some acid-neutralising ability.

All Entwistle water, it will be remembered, undergoes sand filtration at Sweetloves before being distributed to the mains.

No provision is made for the exclusion from Entwistle reservoir of the first rush of storm water after a period of drought.

HEATON (OR HIGH RID) GATHERING GROUND.

This gathering ground, the first of the three to be used for the Bolton supply, is of irregular shape, and comprises about 523 acres. The average annual rainfall at Heaton (for 40 years ending 1898) is 41·9 inches.

About one-half of the area, the lower portion, drains to a 4-foot catchwater culvert which leads from near Old Hall, in the centre of the gathering ground, to Markland Hill filter beds on the eastern boundary. The upper half drains to High Rid storage reservoir, at the western extremity of the gathering ground. Water from High Rid reservoir passes by a 2-foot 6-inch culvert to near Old Hall, where it flows into the 4-foot culvert and so reaches Markland Hill filters. At Old Hall is a small catchwater reservoir, now rarely filled, which has an overflow to this 4-foot culvert.

Physical and Geological Conditions:—This gathering area consists almost entirely of pasture land. The slopes are gentle by comparison with those at Entwistle. The soil is "Middle Coal Measures," nearly everywhere covered by a glacial drift, which is principally clay.

The slopes are almost everywhere under-drained, the land drains leading into the 4-foot catchwater culvert or into small, usually culverted, streams which flow to this main culvert or to High Rid reservoir. Besides water thus derived, spring water is siphoned from the base of a stone quarry (now being worked) to a water-course leading to High Rid reservoir. This reservoir receives a further supply of spring water by way of a tunnel driven into the hillside north of High Rid.

There is little sign of peat anywhere on this gathering ground.

Houses on the Gathering Ground:—The population living on the Heaton watershed area is estimated at 175, living in some 35

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DINGLE (OR BELMONT) GATHERING GROUND.

Area, about 530 Acres. Average Annual Rainfall (for 56 Years ending 1898), 56·9 inches.

Physical and Geological Conditions:—Springs and Dingle reservoirs, which together receive all the water collected from this gathering ground, lie at the foot of a steep hillside, which forms the north-eastern edge of the high tableland of Smithill Moor. Nearly all the collected water passes to Springs reservoir, which is mainly fed by a mountain stream called Daddys Meadows Stream. This stream receives the surface water of the greater part of the gathering ground, and also a considerable volume of spring water conveyed by a tunnel in relation with a natural spring on the hillside called "Daddys Meadows Spring." Dingle reservoir is at a lower level than Springs reservoir, from which nearly all the Dingle water is derived. Water from one or two small streams is occasionally diverted direct into Dingle reservoir. Save for a small area near to the reservoirs which is under pasture, the hillsides are moorland, and are covered with heather. In many places there are irregular terraces along the slopes, which are marshy and peaty. Geologically, the gathering ground consists of shales and grits of the Millstone Grit series, covered in part by glacial drift.

Houses on the Gathering Ground:—There are only three dwellings on this gathering ground, one being the cottage of the caretaker of the waterworks, the other two being small farm-houses, North Farm and Meadows Cote. The latter farm belongs to the Bolton Corporation, the former to a private owner. The moorland portion of the gathering area is let to the Corporation on long lease.

Opportunities of Pollution of Water derived from Dingle Gathering Ground:—North Farm abuts on North Dingle brook, a small stream, part of which is diverted, below the farm, into Springs reservoir, part into Dingle reservoir. We noticed that a considerable quantity of rubbish from the farm-house had been thrown into the bed of the brook, which at the date of our inspection, after nearly a fortnight without rain, was almost dry. By the side of the brook is a tank for slop water, stated to be drained to a field below, but which is liable to overflow into the stream. Drainage from a manure heap, along with some slop water, accumulates on a patch of land below the farm, in a position where rainfall must needs wash polluting matter into the North Dingle brook above the point where it is diverted to Dingle reservoir.

The field below Meadows Cote Farm is crossed by two stone culverts, leading respectively to Dingle and to Springs reservoirs. These culverts, which are close under the surface, and "laid dry" in their upper portion, can admit matters which have soaked through the soil around them. One of these culverts is crossed by the overflow from a tank in the higher part of the same field, which receives slop water from the farm and drainage from manure heaps. Where this overflow crosses the culvert there were signs of soakage of tank contents into the soil. Privy pails had been emptied on the same field, within a few yards of these culverts.

Dingle Water in Respect of Lead dissolving Properties:—Dr. Houston found in 1896 that the water of Springs reservoir, of Dingle reservoir, and of Daddys Meadows stream was in each instance distinctly acid. Springs water was tested for its action on lead, and was found to dissolve lead to a considerable extent.

Dr. Houston pointed out that acidity and plumbo-solvent ability might have been expected in view of the exceptionally peaty character of the soil of Dingle gathering ground, and the numerous points thereon where rain can stagnate in peaty and mossy beds and in marshy places.

At the date of Dr. Houston's visit there had been recent heavy rainfall, and the streams were running fuller than usual. At the date of our visit there had been scarcely any rain during the previous ten days; there was little water in the streams, and considerably the greater portion of water reaching the reservoirs was spring water. One of us collected small samples in stoppered bottles (1) from North Dingle brook, above the point where it is diverted to Springs reservoir, (2) from a land drain entering North Dingle brook opposite the point where this stream is diverted to Springs reservoir, (3) from Dingle reservoir, (4) from Springs reservoir, (5) from the point of entry of Daddys Meadows stream to Springs reservoir, (6) from Daddys Meadows stream, (7) from the outlet of Daddys Meadows Spring tunnel.

Dr. Houston has been good enough to test these samples for us with lacmoid. He found North Dingle brook sample (1) very slightly acid; land drain sample (2) neutral; Dingle reservoir sample (3) very slightly acid; Springs reservoir sample (4) distinctly acid; Daddys Meadows stream and springs samples (5) (6) and (7) neutral.

Thus it would seem that Dingle and Springs reservoir waters are capable of retaining their acidity (and correspondingly their plumbo-solvent ability) when, owing to a period of dry weather, little but spring water is reaching the reservoirs.

There is an overflow from the western end of Springs reservoir to "Three Nooked Shaw Brook" below. But no arrangement is made for the exclusion from Springs reservoir of the first flood water which comes down when a storm succeeds a period of dry weather.

WATER FILTRATION.

Sweetloves Filters.

The filter beds, which were constructed in 1885, receive:—

(*a*) An estimated average volume of about four million gallons a day from Entwistle reservoir,

(*b*) An estimated average volume of about one million gallons a day from Dingle reservoir

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Sweetloves reservoir is said not to have been emptied out within the memory of the waterworks officials.

Heaton Reservoir, capacity 500,000 gallons, receives all water from Markland Hill Filter Works (the principal supply), and also water carried to it from Sweetloves Filter Works by an 18-inch main.

As to possible *opportunities of pollution of* water in this reservoir, we may note that at the date of our visit the grass margins had been freely manured with stable refuse. We learnt that when this reservoir was last emptied out a spring was found in the bottom. It is probable that this water is derived from slopes of Markland Hill, just above the reservoir. These slopes were heavily manured at the date of our visit.

GENERAL OBSERVATIONS AND SUMMARY.

The Bolton Corporation purvey water to over a quarter of a million population, and derive a large profit from their water undertaking.* They have added to their waterworks at sundry dates, have constructed filter beds and reservoirs; on certain parts of their gathering areas, notably at Heaton, they have culverted streams and done other work of a similar character; and, on their Entwistle gathering area in particular, they have now purchased a considerable part of their gathering grounds.

But while credit may be given to the Corporation for action in the above sense, the facts which we have set out above indicate that in several important respects they have neglected to take adequate precautions for safeguarding the purity of the water they supply.

We cannot doubt that the conditions found by us on each of the three gathering grounds are attended by risk of dangerous pollution of the water derived from them; and although the bulk of the water obtained from these gathering grounds is filtered before reaching the consumer, it would seem that the filtration which is practised can by no means be depended on to uniformly remove this risk.

Opportunities of pollution, such as we have indicated, are not difficult of detection. And the negligence which we think attributable to the Bolton Town Council in the matter lies in their having made little effort to obtain systematic information of objectionable conditions obtaining upon their gathering grounds and waterworks. We would draw attention to the circumstance that the Waterworks Committee of the Town Council appear rarely, if ever, to have sought the advice and services of the borough Medical Officer of Health; indeed, it is doubtful whether since the present Medical Officer of Health, Dr. Gould, was appointed, in 1896, he has ever found himself in such relation with the Waterworks Committee as would enable him effectually to draw attention to the multifarious considerations of public health which arise in connection with the water undertaking. As a matter of fact, we found Dr. Gould had been able to acquire little knowledge about the gathering grounds or the waterworks.

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* According to the current "Corporation Year Book," the sum derived from the water undertaking transferred in aid of the Borough rate, 1897–98, was £13,848.

There are, it is true, certain men in the employment of the Corporation who are required, along with other duties, to inspect the gathering areas. But we saw little indication that these men undertake the systematic day-to-day inspection which here seems so needful; moreover, they are not acting under skilled supervision, and thus it is likely that they often do not know what are the conditions which should specially be looked for and guarded against.

Given frequent and efficient inspection, the Town Council would probably find little difficulty in preventing pollutions such as we have described. In many cases the land and houses on the gathering area now belong to them; elsewhere, as at Heaton, the gathering area is wholly within the borough; while, as regards land and dwellings of private owners who are unwilling without assistance to make needful improvements, it would seem reasonable, in view of the important issues involved, for the Corporation to contribute to the expense.

Question of lead-dissolving ability of the Bolton water seems to arise only in respect of the Dingle supply, which appears capable of acting decidedly upon lead. A portion of this Dingle water mingles at Sweetloves with a much larger volume of neutral Entwistle water and is then filtered, and it may be assumed that this filtered mixed water is unlikely to have any conspicuous lead-dissolving properties. The rest of the Dingle supply has up to now been discharged without filtration into a high-level main which, since it was extended last year, serves some 15,000 persons. This arrangement seems attended by risk.* It is true that we did not learn of lead poisoning among the population served by this high-level main. But until 1898 almost the whole of this high-level area was outside the borough, and cases of the sort, had they occurred, would not have been likely to have come to the notice of the officers of the Corporation. Moreover, no attention had locally been drawn to the lead-dissolving property of the water, and no inquiry had been made for cases of lead poisoning in this high-level area.

The proposal of the Town Council to adopt ordinary sand filtration for all water passing to this high-level main appears commendable, and it is not unlikely that if the water be continuously dealt with in adequate and properly constructed filter beds, the filtration process will ordinarily suffice to deprive it of

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* We were informed that domestic lead water pipes newly provided within the Bolton water-supply area are required to be lined with tin. Use of tin-lined pipes may be thought of as diminishing the risks of water capable of dissolving lead, but their employment, even if universal, could hardly be depended upon for safety so long as active lead-dissolving properties were possessed by the water.

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lead-dissolving properties. It would seem advisable, however, that the Town Council should keep in mind the principal object of these filters, and that when the work is completed they should assure themselves by adequate experiment that the filtration has effected its purpose in regard of lead, and that they should be, if necessary, prepared to take additional precautionary measures.

Lastly, it would seem that, as regards access to the water both of polluting matters and of substances derived from peat which render the water capable of acting upon lead, the period of greatest risk is probably when a spell of comparatively dry weather is succeeded by sudden and considerable rainfall. The Town Council might usefully take into consideration the practicability of adopting, on their several watershed areas, arrangements by which the first rush of storm water shall be automatically excluded from their water service.

No. 10.

On Sanitary Circumstances and Administration of Aldershot, and on Diphtheria therein; by Dr. Reece.

REPORT on the GENERAL SANITARY CIRCUMSTANCES and ADMINISTRATION of the URBAN DISTRICT of ALDERSHOT, with SPECIAL REFERENCE to the PREVALENCE of FATAL DIPHTHERIA therein; by Dr. R. J. REECE.

ORDER OF REPORT.

A.—PRELIMINARY.

1. Reason for Inspection.
2. Previous Inspections in consequence of Diphtheria.
3. The Registration Sub-district.
4. Geology.
5. Area, Population.
6. Occupation of inhabitants.
7. Artificial division into "Town" and "Camp."

B.—THE "TOWN" AND ITS GENERAL SANITARY CIRCUMSTANCES.

8. Water supply.
9. Sewerage.
10. House drainage and Excrement disposal.
11. Sewage Farm.
12. Refuse disposal.
13. Roads.
14. House accommodation.
15. Back yards.
16. Common Lodging-houses.
17. Houses let in lodgings.
18. Overcrowding.
19. Footpaths and Byeways.
20. Isolation Hospital accommodation.
21. Mortuary.
22. Slaughter-houses.
23. Dairies, Cowsheds, and Milk Shops.
24. Keeping of Animals.
25. Offensive Trades.
26. Schools.

C.—SANITARY ADMINISTRATION IN THE "TOWN."

27. Constitution of the Sanitary Authority.
28. Medical Officer of Health.
29. Inspector of Nuisances.
30. Surveyor.
31. Acts and Byelaws adopted.
32. Regulations for Dairies Cowsheds. and Milk Shops.
33. Action taken in connexion with Infectious Disease.

D.—THE "CAMP" IN ITS RELATION TO THE TOWN.

34. General Sanitary Conditions of the Camp and Sanitary Administration so far as they have a bearing upon prevention and control of Diphtheria in the District.

E.—GENERAL CONSIDERATIONS ON THE PAST AND RECENT PREVALENCE OF DIPHTHERIA AT ALDERSHOT.

35. School influence on Diphtheria in the Town.
36. School influence on Diphtheria in the Camps.
37. The influence of Infection spread from person to person (*a*) in the Town, (*b*) in the Camps.
38. General considerations concerning the Town with reference to Diphtheria.
39. Statistics of Diphtheria mortality and attack in Aldershot Town and Camps.
40. Considerations on and comparison of the Sanitary Administration in the Town and in the Camps with reference to Diphtheria prevalence.

On Sanitary Circumstances and Administration of Aldershot, and on Diphtheria therein; by Dr. Reece.

A.—PRELIMINARY.

1. *Reason for Inspection.*—In view of the continued fatal prevalence of diphtheria in the Aldershot Urban District, shown in successive Quarterly Returns of the Registrar-General, I was instructed by the Board to make inquiry into the circumstances in which the disease has prevailed.

The inter-relation of the Town and the Camp is such that the Board duly notified the fact of my inspection to the War Department, and requested that the military authorities should be instructed to furnish me with such assistance as I required. This assistance was cordially given.

2. *Previous Inspections in consequence of Diphtheria.*—The district has twice previously been inspected and reported on by the Board's Inspectors in consequence of the prevalence of this disease,—in 1885 by Dr. Sweeting, who reported on the Registration District of Farnham, in a Sub-District of which the Urban District of Aldershot was included, and in 1887 by Dr. George Turner.

3. *The Aldershot Registration Sub-District.*—Since the reports of the inspections referred to were written, the Registration District of Farnham, which consisted of the Registration Sub-Districts of Frimley and Farnham, has been divided into three Sub-Districts, Aldershot, Frimley, and Farnham. This rearrangement of the districts took place in 1897. The Registration Sub-District of Aldershot is co-terminous with the Urban District of Aldershot and with the civil parish of that name.

The Aldershot Urban District, although in the county of Surrey for registration purposes, is at the north-east corner of Hampshire, and is within the jurisdiction of the County Council of Southampton.

4. *Geology.*—Towards the south of the district the town stands on London Clay, and to the north, on the Lower, Middle, and Upper Bagshot Sand. The eastern portion of the southern boundary of the district, and the whole of the eastern boundary is formed by the river Blackwater, along the banks of which stream the soil is alluvial.

5. *Area and Population.*—Comprised within the boundaries of the Urban District of Aldershot is the whole of that portion of the Aldershot Military Camp, known as the South Camp, and also a portion of the North Camp* which, however, is practically uninhabited; it has no barracks built on it, therefore no population.

The area of the Urban District is 4,178 acres, divided thus—

	Acres.
Camp	2,746
Town	1,432
Total	4,178

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* The Military Camp of Aldershot is divided into the South Camp and the North Camp. The North Camp borders on the village of Farnborough, and has comparatively but little inter-communication with the town of Aldershot, which is a mile distant and approached over a hill.

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The town of Aldershot sprang into existence in consequence of the establishment of the military camp in the early fifties. Of recent years, owing to the action of the War Department in abolishing the old wooden huts of the camp and replacing them by permanent buildings of brick, the building trade of the town has been in a flourishing condition; many fresh houses have been erected, and many are yet building. By the courtesy of the Registrar-General the following table has been prepared from the records of his Office. It gives the number of inhabited houses in the urban district, and the population at the five census periods 1851, 1861, 1871, 1881, and 1891:—

——	1851.	1861.	1871.	1881.	1891.
Houses inhabited	159	763	1,175	1,570	2,182
„ uninhabited	4	49	90	199	88
„ building	—	11	21	9	28
Population in Town—Total ...	875	4,977	7,523	9,727	12,641
Males ...	438	2,593	3,409	4,584	6,240
Females ...	437	2,384	4,114	5,143	6,401
Population in South Camp ...	—	11,743	14,159	10,428	12,954
Military	—	8,965	10,067	7,280	9,992
Other Males ...	—	844	1,299	983	931
Females	—	1,934	2,793	2,165	2,031

These figures show the great increase of population in the district during the forty years to which they refer, and there is evidence that so far as the town is concerned the increase continues. I learn through the Rate Collector that at the present time the number of assessments in the district is 3,087; deducting from these figures 234 as being the number of lock-up shops, stables, workshops, &c., the number of inhabited houses would be 2,853.

It is no easy matter to estimate the population of the town with any degree of accuracy. From the table given above it can be deduced that in 1861 the average number of persons in each house was 6·5, and in 1871 it was 6·4. In 1881 the number had fallen to 6·2 and in 1891 to 5·8. Taking the latter rate of persons per house, the civil population of the district at the present time would be about 16,500 persons.*

I learn that the average population of the South Camp during 1898 was:—

Men	11,299
Women	1,007
Children	1,588
Total	13,894

The number of persons resident in the Aldershot Urban District, however, is far from stationary. At Easter and Whitsuntide, and during the summer, the numbers in the Camp are swelled by

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* At the census of 1891 the number of inhabited houses in the Civil Parish of Aldershot was 2,182, and the number of families or separate occupiers was 3,069. This means that certain of the houses are let out room by room.

Militia and Volunteer Regiments coming into the Camp for longer or shorter periods, and by the addition of various bodies of troops drafted in for special instruction. With the advent of these the number of inhabitants in the town is increased by the wives and children of certain of the soldiers, and by the usual camp followers. Again, Aldershot borders on a hop country, and at the hop picking season a certain number of the hop pickers take up their residence in the town of Aldershot.

6. *Occupation of the inhabitants.*—The chief industries of the district are shop-keeping, on larger or smaller scale, and the letting of lodgings. Lodgings range from whole houses let to officers, their wives and families, to single rooms let to the soldier and his wife. There are neither resident gentry nor manufactories. The town of Aldershot exists by reason of the Camp.

7. *Artificial division into "Town" and "Camp."*—It will be convenient to consider the district for purposes of this report in its two great divisions: "the Town," occupied by the civil population, and "the Camp," which is the property of the War Department.

The inhabited part of the North Camp is in the Registration Sub-District of Farnborough. The following population is recorded at the census periods for the North Camp:—

——	1861.	1871.	1881.	1891.
Population in North Camp	4,671	4,260	3,538	3,979
Males	4,150	3,517	3,060	3,401
Females	521	743	478	578

B.—"THE TOWN" AND ITS GENERAL SANITARY CIRCUMSTANCES.

8. *The Water Supply* for the Urban District is in the hands of a private Company, "The Aldershot Gas and Water Company."

I am indebted to Mr. A. J. Wilson, the Chairman of the Company, with which he has been closely connected for some 25 years, for much of the following information.

At one time, some 30 years ago, the Company procured their supply of water from the gravel strata at the southern part of the district, but owing to the increase of the Town, and, to a certain extent, the difficulty of ensuring the gathering ground from pollution, borings have been sunk through the London Clay to the Chalk, and I am informed that no water is now distributed by the Company to the public which is not derived from the Chalk: the water from the Bagshot Sand being only used for condensing or cooling purposes in connexion with the engines. The borings are sunk at the extreme southern boundary of the Aldershot Urban District, and there are nine boreholes carried through the clay to a depth of 220 to 300 feet from the surface, eight of which are connected together to facilitate pumping. The pumps are placed 38 feet below the surface of the ground, and the water rises to within 22 feet of the surface. It is said that even after heavy pumping the water has never been known to sink below 38 feet from the surface.

There are three sets of gas engines, each having a treble set of pumps, and each set of pumps is of 25 horse power nominal, and four sets of steam engines of a total 42 horse power nominal, contained in two separate buildings.

The pumps in each building are capable of throwing 50,000 gallons per hour. The gas engine plant is almost entirely used under ordinary circumstances, and one pump is always kept going night and day, two or three additional pumps being brought into use during the daytime as required.

The Company also supply water to the military camp as required, and on 16th February last 455,000 gallons were pumped to the camp, and 386,000 gallons to the town, making a total of 841,000 gallons supplied in 24 hours. This amount by no means represents the maximum output of the Company, as their books show that over 1,000,000 gallons were supplied one day last summer.

There is ample margin of pumping power: provided such an amount of water could be obtained, it is possible that the engines could raise twice as much water as has yet been required in any 24 hours.

It is estimated that an average quantity of 25 gallons per head is consumed in the town of Aldershot. The Company have 2,705 houses on their books, and thus there must be some 148 houses where the water supply is derived from wells or surface springs, or which have no water supply.

The water is pumped from the wells direct to two service reservoirs at "Reservoir Hill," formerly called "Anger Copse." This is the highest point in the town, and the water is delivered thence by gravitation. The supply is constant. No instance of a cistern for water supply for domestic purposes, other than the flushing cisterns of water closets, came under notice.

The greater proportion of the houses have the water supplied inside the buildings, but there are several rows of cottages to which water is only laid on to a standpipe in the yard.

The water is hard, about 16 Clark's scale, but is reported to be of great purity.

Local Wells.—The number of houses supplied from wells is becoming insignificant. The majority of the wells are presumably to be found in the outskirts of the town at farm-houses, &c., and the water from these wells is often used for dairy purposes. Nevertheless wells are, as is mentioned below, to be found in the populous parts. Such private wells as came under inspection are all constructed after the same principle, and differed only in depth and in the degree to which they are liable to pollution. They are dry-steined surface wells. The depth of the well varies with its position in the district. On the high ground, at Queen's Road, one well was observed which was said to be 36 feet deep, and where a windlass was used to lower the pail by an iron chain, the water apparently standing some 25 feet to 30 feet from the surface. From this to wells a few feet deep, where the water stood at the level of the surface of the ground, all varieties were observed. Most of them were imperfectly protected against surface drainage, the covers nearly always being dilapidated

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wooden structures, and often the well was so surrounded with organically polluted soil as to render the water almost certainly liable to gross pollution. Nevertheless, one well a few feet deep was observed where the water stood within a few inches of the ground level; within some 20 or 30 feet and situated on slightly higher ground than this well was an undrained and filthy farm-yard, where manure thrown from the cowsheds was allowed to collect: a sample of the water from this well is said to have been submitted for chemical analysis and not to have been condemned. From a study of the surroundings of this well it is almost impossible to conceive that the well water could escape pollution.

One house* was observed where the water supply was derived from a hole in the ground; immediately adjoining this hole, separated only by a fence, and on higher ground, was on one side a highly manured garden, and on another side ground which by use had become a sort of refuse tip. The houses in the immediate neighbourhood are not connected to the main sewerage system, and the excrement and slop drainage is disposed of on the land adjoining the houses.

For some time past the District Council have submitted samples of well water for analysis, and of the samples so submitted some eighty per cent. have been condemned, and the wells ordered to be closed by the Council. Still, although the order has been made by the Council, it is quite manifest that it has not always been observed, owing, perhaps, to the popular prejudice in favour of the well water.

In the most thickly populated part of the town one pump was seen, which is said to be connected with a surface well almost immediately below it. It stands in the roadway, the houses on one side of which are cottage property. The water from this pump was submitted for analysis, condemned, and the well closed by order of the Council. On the day of my visit a padlock and chain lay on the ground near the pump, from the spout of which water was trickling. There was nothing to prevent children from drinking this water.

9. *Sewerage.*—From the time that Aldershot began to be a town of importance, sewers have been laid down; but the Sanitary Authority and later the District Council would appear never to have succeeded in completing a satisfactory scheme of sewerage. From time to time the authority have applied to the Local Government Board for sanction to borrow money for additions to, or alterations of, the existing sewers, and many local inquiries have been held by the Inspectors of the Engineering Department of the Board. Such loans have not always been raised when sanctioned; and it would appear that occasionally, when the work has been done, it has not been carried out in its entirety.

There is little doubt that some of the original sewers laid between 1850 and 1860, and perhaps even later, are merely puddled with clay at the joints of the pipes, and it is scarcely conceivable that such pipes do not leak.

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* Since this Report was written I have learnt this house has been closed as unfit for human habitation.

There is no lack of fall in the system, taken as a whole, but the Authority have had constant trouble with the sewers, and some of them silt up. Parts of the localities not originally included in the sewer system have had to be sewered owing to the increase of buildings, and ejectors have been inserted to force the sewage from certain low-lying portions to the higher levels of the sewer system.

At the present time the District Council are fully alive to the defects of the sewer system, and are endeavouring to make good the deficiencies. A separate system of sewers for storm water to relieve the main sewers, and to lessen the quantity of liquid to be dealt with at the sewage farm, was commenced many years ago, has been from time to time added to and extended, and is not yet complete.

The system of storm water sewers takes the surface water from the roads, and the front roofs of houses; the back roof water passes, as also the rain water from the yards, to the ordinary sewers. These storm water sewers as a rule run parallel to the main sewers in the streets. There are still houses in the district whose cellars and basements are flooded during heavy rain.

The storm water sewers discharge by two main outfalls into the River Blackwater on the eastern boundary of the Urban District, the northern outfall being by Back Cutting Wood, near the Basingstoke Canal, and the southern outfall by Ash Bridge.

The sewers receiving the house drainage commence as stoneware pipes 8 inches and 9 inches in diameter; these converge to 12 and 15 inch sewers, until at the point where Victoria Road joins the High Street, the main sewer has a diameter of 18 inches. This calibre is maintained until Herrett Street is reached, from which point a cylindrical brick sewer 24 inches in diameter and some 1,350 feet long, takes the sewage to the sewage works.

Altogether there are some 14 miles of sewers in the district, without reckoning the surface drainage.

The majority of the sewers are laid at a considerable depth from the road surface.

Many of the original sewers were not laid in straight lines from point to point, but were carried in curves.

From time to time certain of the older sewers have been relaid on more modern methods, and manhole inspection chambers have been added as thought fit. Some of the manholes of the older system have catch-pits below the level of the sewers, evidently with the idea of stopping sand being carried to the lower portion of the sewerage system. These catch-pits stop the solid sewage matters as well as the sand, and they are ventilated to the roadway by gratings; they have often proved a nuisance by emitting disagreeable odours. The present Surveyor is endeavouring to rectify the construction of such manholes, but much work in connexion with them yet remains to be done.

Ventilation.—The sewers were originally ventilated by gratings at the street level. These proving a nuisance, owing possibly to the solid nature of much of the sewage, due to the fact that many water-closets were hand-flushed or not flushed at all, they were either closed by the officers of the Council or blocked up by such of the neighbouring inhabitants as suffered most from them. To effect ventilation, some 19 ventilating shafts, 6 inches in diameter, were erected against buildings where permission could be obtained, and two were set up by the kerb of the pavement.

Many of the ventilating shafts after they emerge from the ground are not carried up straight, but often have curves or bends in their course, thus vitiating to a great extent the object for which they were erected. One instance was observed where a rain water gutter of a house was discharged into the head of a public ventilating shaft. As may be readily imagined, it has been found that 21 ventilating shafts are insufficient to ventilate the 14 miles of sewers, and recently the Urban Council have applied to the Board for sanction to borrow money to erect some fifty steel ventilating columns 30 feet high and 6 inches in diameter at the dead ends of sewers. After local inquiry by an Inspector of the Board's Engineering Department, this sanction was granted—24th November, 1898—but at the end of February in the present year the work had not been commenced.

Flushing.—The sewers are supposed to be self cleansing, but, as a matter of fact, there are certain sewers which do not fulfil this requirement. At West End there is a storage tank for rain water which is used to flush the sewers in that locality, and there are sewers in Church Street, Crimea Road, Little Wellington Street, North Dane, Malthouse Lane, Wellington Terrace, and the Brighton Road, which are flushed every alternate week in fine weather, by means of a hose pipe and water van. It would seem advisable that some automatic system of flushing should be supplied at the dead ends of the sewers.

10. *House drainage and excrement disposal.*—The house drains are said to be composed of glazed cylindrical earthenware pipes, 4 inches in diameter, in all recently erected buildings, but the older house drains vary in size. The 4-inch drains from two or more houses are often joined into a common drain, 6 inches in diameter, before passing to the main sewer. In most cases the house drains appear to be outside the houses, though from the way the ground has been built on, and the close aggregation of dwellings in places, many drains are of necessity carried through or under the buildings. In many even of the smaller houses the sink is placed inside the house, but in the great bulk of these the sink pipe opens into the open air, over or near a gully.

Excrement disposal is effected principally by the water-carriage system. There are but few privies, and these are for the most part situate in the outlying parts of the district, such as Eggars Hill, Boxalls Lane, the Dog Kennels, and Aldershot Stubbs.

In most of the better class dwellings there are at least two water-closets to each house, one inside the building and one out; and an inside and outside water-closet are to be found in smaller houses which have been recently erected, and, not unfrequently, there is a bath-room associated with the inside water-closet. Again, there are houses with only an inside water-closet, but for by far the greater number there is only an outside water-closet. The number of water-closets of all classes dependent on hand flushing for cleanliness is variously reckoned at between 25 and 30 per cent. of the whole. The pattern of closet most in use is one or other variety of hopper; many pans are cracked, and a certain number neglected. Instances were observed where one water-closet did duty for two or more houses, but such an arrangement is uncommon.

The soil pipes of the water-closets are often unventilated, though it has been the custom of late to insist on the ventilation of the soil pipes when infectious disease has been notified in a house. Thus it comes about that the houses in which infectious disease has occurred can to a great extent be recognised by the fact that the house drains have been ventilated. With the order to ventilate the drains, an order is also made to supply flushing apparatus to the water-closet, and many of the old hand-flushed closets have disappeared in favour of a water-closet supplied with a flushing tank. In the newly erected houses, and in all recent alterations, the soil pipe is ventilated by a shaft carried up straight, and of full bore; but this is the exception rather than the rule in the older houses, and also in cases where modification of the closet arrangements has not been made within the last three years.

The connexion of the house drains with the sewers is faulty in many cases, as it has been the practice in making such connexions to cut a hole in the side of the sewer, and insert into it the spigot end of the drain pipe, the gap between the circumference of the hole cut and the inserted pipe being filled in with cement. Such joints are defective in construction, and must of necessity nearly always leak, or allow entrance of ground water to the sewers. It is only within the last two years that the connexion has been made with a proper sewer eye and bend. Joints made on the older method still remain to an unknown number.

There are several localities in the district where the houses are unconnected with the sewer system, and some of these houses drain to cesspools, occasionally of a most primitive kind. The subject of dealing with these localities in the way of furnishing them with sewers, and the project also of dispensing with the present ejectors on the existing sewerage scheme, are at present occupying the attention of the Council. The construction of such new sewers, if properly carried out, cannot fail to be of great sanitary advantage to the district.

Only quite recently a certain common lodging house situated in that part of the town most thickly built over was found to have its drainage to cesspools in the yard. There appeared to be no overflow provided to these cesspools, and for many years the sewage matter therefore must have found its way into the surrounding soil.

11. The *sewage farm* of the town is situated at the south-eastern part of the district near Ash Bridge. The River Blackwater borders the eastern side of the sewage farm, and it is into this river that the effluent is discharged. At one time this farm was managed by contractors who were paid for their services; at present it is

worked by the District Council, through a committee of which Mr. W. T. Robertson, J.P., is chairman. There is a farm bailiff who receives a salary of 35s. per week.

The crude sewage is delivered at the farm to a pump well, whence it is raised to a small tank by two (duplicate) centrifugal pumps by engines worked by steam power. The sewage while flowing through the small tank is treated with Gobb's alumina, and passes then to the settling tanks. From the settling tanks part of the sewage is directed on to land for treatment by broad irrigation, for which purpose there are about 28 acres, and part passes to bacterial filters, recently erected by the Council, the effluent from which is passed over a small piece of land before joining the main effluent, which discharges at the north-eastern extremity of the farm to the river. The filter beds are five in number, one of which has a layer of gravel, above which is crushed clinkers, the remaining four having no gravel. Locally it is imagined that if a larger number of these bacterial filters be provided, treatment of sewage on land might be dispensed with.

Rye-grass is grown on the land, and forms the staple crop; there are but few osiers.

The sludge from the precipitating tanks is removed, apparently at his convenience, by a contractor to a farm which is stated to be outside the Urban District.

There is a storm tank provided at the sewage works to receive the excess of sewage during heavy rainfalls. The overflow from this tank passes direct to the River Blackwater. The excess of sewage is pumped from this tank as occasion offers, and is dealt with on the farm along with the crude sewage in the manner already stated.

The level of the ground water in the neighbourhood of the farm is near to the surface; this fact renders it difficult to dispose efficiently of much liquid sewage on the farm. At the time of my inspection there had been heavy rain for a considerable period, and the whole farm had the aspect of being waterlogged.

12. *Refuse disposal.*—The removal of house refuse is contracted for. Householders deposit it in buckets and boxes, which, being placed outside the buildings on the street kerb, are emptied thrice weekly by the contractor, and their contents removed to a tip at "the Gold" open ground near the eastern boundary of the district. The contract covers all the Urban District (excluding "the Camp"); but there are certain outlying parts unvisited by the contractor's carts.

This method of collection has resulted in the almost total disuse within the town of fixed receptacles for refuse, but incidentally the method as practised at Aldershot has drawbacks. Should the contractor's cart be late in its round, and at all times when windy weather prevails, the contents of these receptacles to a greater or less extent get scattered on the roadway; scarcely one was observed which was fitted with a close cover.

Where fixed receptacles are retained, and are still used, they are never apparently emptied by the contractor's men, and they become a source of great nuisance. As an instance, one, in the angle of a yard, measured about 6 feet by 6 feet superficially, the two walls proper to it being some 2 feet high. Owing to the refuse being heaped some 2 feet to 3 feet above these side walls, the structure of the floor of the ashpit, and whether or not it was sunk below the ground level, could not be ascertained. This receptacle was uncovered, allowing the rain to fall into it. The yard in question, which is at the back of shops facing on different streets, at right angles to each other, in the most populous and prosperous part of the town, is used in common by a baker and pastry cook, and a linen draper. This ashpit was stated to be emptied not more frequently than twice yearly.

13. *Roads.*—There are within the district :—

Dedicated roads	20½	miles.
Undedicated roads	5⅕	„

The kerbing and guttering of the roads, although somewhat defective, have been considerably improved of late. As a rule, roads are well and cleanly kept, being regularly scavenged by men employed by the Urban District Council.

The roads in the Urban District have more traffic over them than is usual in a town of the same size. The number of horses in the Camp of Aldershot usually amounts to about 3,500, and there is a strong contingent of Artillery, and of the Army Service Corps, with their necessary trains of waggons. For Camp purposes use is naturally made of the roads in the Urban District. This leads to extra wear of roads, and also imposes the need of more frequent scavenging of the district.

14. *House Accommodation.*—Aldershot is an example of a town built in a hurry. In the centre of the town the houses are crowded together, and backyards have been utilised for the erection of warehouses, stables, &c. Towards the outskirts there is more facility for the circulation of air about dwellings. With comparatively few exceptions, the buildings are not of a superior class. The average householder here cannot afford to pay a high rental. During the last two years more attention has been given to houses in process of building, and the building byelaws have been much more strictly enforced than was formerly the case.

Speaking generally, the eave-spouting of houses is defective throughout the district, with the result that the walls and footings of dwellings are often damp. The dampness of the foundations is often due to rain-water pipes terminating 3 or 4 feet from the ground, having originally been intended to discharge over a water butt. With the extension of the water service to the houses, the necessity of having a water butt has ceased to exist, and rain-water butts have almost disappeared. Meanwhile the rain-water pipe has not been led to a drain, nor has the necessary gully been supplied.

There are several houses of the back to back type, *i.e.*, without means of through ventilation. Some of the older houses are partly built of wood, and one or two were observed which were manifestly unfit for human habitation.

15. *Back-yards.*—There is a general absence of paving of back-yards, and in such back-yards as are paved the paving is often

defective. Many back-yards are shared in common by several houses. Some of the smaller houses have their back gardens separated from one another by open wooden palings, which allow of a greater freedom of circulation of air than would be the case if two gardens were contained by brick walls.

The condition of the back-yards will be referred to again under the heading "24. Keeping of Animals."

16. *Common Lodging Houses.*—There are nine common lodging houses on the register. They vary very considerably as to their cleanliness, and as to the provision of sanitary requirements. Certain of them are extremely neat and well kept. There are, however, instances where washing accommodation for the lodgers can scarcely be said to exist; others where the cubic space allotted to each bed falls far below 300 feet. Notices, which should be displayed, showing the number of lodgers the room was licensed to accommodate, are often absent, and, if present, illegible. Beds are now and again in excess of the number for which the room was licensed; floors are unscrubbed and dirty; dust is thick on window-sills, showing the windows have been kept unopened for considerable periods; fireplaces are boarded up, and partitions between the beds of married couples do not screen the whole of the bedsteads, nor reach to within six inches of the floor. In other words, the byelaws regulating the keeping of common lodging houses are flagrantly violated.

17. *Houses let in lodgings.*—There are rows of large houses, *i.e.*, houses of more than two stories, built in the early days of Aldershot, which are now let in lodgings, each of one or two rooms, to a plurality of families. The sub-letting of such houses is a special feature, peculiar to the district. It would seem desirable that such tenement houses should be regulated by byelaws.

18. *Overcrowding.*—Overcrowding of persons in houses is not often brought to the notice of the District Council. It is said that such overcrowding, if it exists, is difficult of detection. Still, there can be no question that at times overcrowding must exist in certain localities, and attention should be directed to this matter with a view to regulating "tenement" houses by special byelaws.

19. *Footpaths and byeways.*—There are many footpaths and byeways giving access to back-yards in Aldershot. As a general rule they are unpaved, undrained, and in wet weather sloppy and generally unclean. Such footpaths should receive the special attention of the District Council.

20. *Isolation Hospital Accommodation.*—With the exception of a galvanised iron hut erected on a brick foundation at the Sewage Farm, and hurriedly put up to receive a case of small-pox, the Urban District Council were until quite recently without isolation hospital provision. The iron hut has been of late occupied as a residence by a man employed on the Sewage Farm.

In March, 1898, the Urban District Council purchased, for the purpose of building thereon an Isolation Hospital, a piece of land three acres in extent, along with a right of way to it from Cemetery

Road 20 feet wide. The land adjoins the cemetery towards the North Town portion of the district.

The surface of the site is fairly even, and there is a gentle slope to the north. The subsoil is sandy, and it is not anticipated that it will be necessary to underdrain the land in question. It is surrounded by a quickset hedge on two sides, the 6-feet brick wall of the cemetery forms a third boundary, and the garden hedges and palings of a row of small houses close to it on the fourth side. A main drain has been laid to join the public sewer of the district, and the gas and water mains have been carried on to the site.

On this piece of land there has been erected an Administration Block, which has been so arranged that patients can be received and treated therein while the hospital ward pavilions are being built. A building and apparatus for disinfection, after the pattern of Washington Lyon, with separate chambers for the infected and disinfected articles, have been provided.

A ward pavilion, separated into two wards of four beds each, with a nurse's sitting-room between them, is in course of erection.

These buildings are of brick.

At the time of my inspection the Administration Block was completed but not furnished, and no patients had yet been treated on the site.

As application for permission to raise a loan for the purchase of the ground and for erection thereon of an Isolation Hospital has not been made to the Board, the plans, &c., of the Hospital have not been submitted to the Board for approval.

21. *Mortuary*.—There is a mortuary standing in the yard of the Urban District Council. It is built of brick and has a properly cemented and drained floor. This was erected in 1883.

There was at one time a dead-house at the cemetery. About 1884 the slates from the roof of this building were removed and glass substituted, and it was used as a conservatory. It is now utilized as a tool house.

22. *Slaughter Houses*.—There are three licensed slaughter houses in Aldershot; on the whole they appear to be fairly well kept. It would be of advantage if cisterns were placed in each some distance above the ground to provide adequate force and sufficient quantity of water for flushing purposes.

23. *Dairies, Cowsheds, and Milkshops*.—There are 10 cowkeepers and 18 milksellers registered in the district.

The greater number of the milksellers only receive a small quantity of milk daily and retail it to their customers. They are tradesmen such as grocers, who supply other commodities. It is stated as regards these retailers that no milk is stored on their premises during the night.

The dairies for the great part are kept clean and are suitably ventilated. Instances were observed where dairies exist in connexion with cowsheds. In such cases the water for washing

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the cans, &c., is obtained from surface wells, sometimes dip wells, the water of which, from the position of the wells close to undrained farm mixens, must be liable to pollution.

Apart from the cowshed at the Camp Sewage Farm, there is no such thing as a "model" cowshed in the district. The greater number of the cowsheds have a brick, or partly brick, floor, the surface of which is irregular and often dilapidated, allowing the liquid manure to settle in small pools and to soak between the bricks. The liquid manure which is not absorbed in the cowsheds finds its way, by means of an open brick gutter, passing at the rear of the beasts' stalls, to the farm mixen, where the dung and litter is deposited, to remain until cleared away as may be convenient. Some of these mixens are said to be drained to cesspools, others are undrained.

The usual arrangement is for the cowsheds to occupy one, two, or three sides of a square, the partially enclosed space forming the mixen.

Most of the cowsheds have a brick wall running at one side, and a wooden wall on a brick foundation at the other. Some are built wholly of wood. In few cases is any attempt made to procure through ventilation by means of windows, &c., although in some cases the cross ventilation is ample owing to the dilapidated state of the buildings.

But few of these buildings could be considered clean. Indeed, from their construction, especially of those whose ceiling is formed by the slates or tiles of the roof, it is almost impossible to comply with the local regulation for the management of dairies, cowsheds, and milkshops: "Cause the ceiling . . . cowshed . . . to be thoroughly lime-whited or coloured: Provided that the foregoing requirement shall not apply to any wall the internal surface of which is painted, or where the material of or with which such surface is constructed or covered, is such as to render the lime-whiting or colouring thereof unsuitable and inexpedient, and where such surface is thoroughly cleansed."

Most of the cows are milked in the stalls.

A large amount of the milk consumed in the district is obtained from outside the urban district.

24. *The Keeping of Animals.*—There are many animals kept in Aldershot; indeed the general impression left upon me after an inspection of the district spread over nearly three weeks is, that there is scarcely a back yard in the town where one or more animals is not to be found. Almost every householder has a watch-dog, often more than one; cats abound, fowls are largely kept, as are ducks to a lesser extent. Rabbits are numerous, and pigeons and doves are not unknown. There are also canaries thrushes, linnets, larks, &c., in cages of varying size.

Pigs, however, are much less abundant than other animals; they are only to be found on the outskirts of the district.

In the most populous part of the town there is one cowshed, but horse-stables are numerous.

Of the animals mentioned, the most serious nuisances arise from the keeping of fowls and horses. Fowls are kept, often in large numbers, in undrained and unpaved back yards, the soil of which has become grossly polluted and must be rich in putrefying animal matter. Many of such yards are of small size and situated in the most thickly populated part of the town.

The nuisance arising from the keeping of horses is associated with the resulting manure. The local byelaws explicitly set forth that a suitable receptacle for manure shall be provided, and so constructed that the bottom or floor thereof shall not in any case be lower than the surface of the adjoining ground, and that it shall be maintained in such a condition as to prevent any escape of the contents thereof or any soakage therefrom into the ground or into the wall of any building; that a suitable cover shall be provided, and the manure, &c., removed at least once in every week.

In the course of inspection only one receptacle for stable manure was observed which was covered over, and many instances came under notice where the byelaws were violated in every particular mentioned above.

One stable was observed towards the centre of the town which was a dilapidated building roughly constructed for the most part of wood in which two horses were stabled. It was undrained; the liquid manure ran into an unpaved yard to join that which had oozed, or had been washed by rain, from the dung heap. The stable manure was held in a heap by open planking immediately outside the stable. There were sundry fowls and some rabbits in the yard, and refuse such as old bottles, scrap iron, &c. The surface of the ground was sloppy and filthy in the extreme. In a contiguous house two fatal cases of diphtheria had occurred. Still the yard had not been dealt with by the officers of the Urban District Council, though the drainage of the dwelling-house had been reconstructed.

25. *Offensive Trades.*—There are no offensive trades carried on at the present time within the district.

26. *Schools.*—There are in Aldershot Town several Public Elementary Schools, and they are distributed are follows:—

At the West End of the Town, in Queen's Road, and close to each other, are—

(*a.*) The West End Board Schools, for girls and infants, built in 1873.

(*b.*) The West End New Board Schools, for boys, opened on 3rd October, 1898.

(*c.*) St. Joseph's Roman Catholic Schools, which have a "mixed school" and an "infant school." They have been built many years.

At the East End of the Town, and also close together, are—

(*d.*) The East End Board Schools at Redan Hill, built in 1874, and afterwards enlarged. They consist of "boys'," "girls'," and "infants'" schools.

(*e.*) The National Schools, High Street, which have a "mixed school" and an "infant school."

Towards the northern part of the district, known as North Town, there is an infant school. It was built in 1865, and taken over by the School Board in 1872.

In addition to the above-mentioned public schools there are many private schools, but they are not, as a rule, of any considerable size.

The older school buildings are naturally not to be compared, either in construction or design, with the recently erected West End Board Schools for boys.

It is worthy of note that the drainage and water-closet accommodation of all the public schools has been recently revised. Every elementary school has now trough closets automatically flushed, and urinals, and, as far as the West End and East End Board Schools are concerned, these were found scrupulously clean and in working order.

C.—SANITARY ADMINISTRATION IN THE TOWN.

27. *Constitution of the Sanitary Authority.*—Under "The Public Health Supplemental Act for Aldershot, 1857," the Local Board of Health was instituted, comprising twelve members, nine of whom were elected by the ratepayers, and three nominated by the Principal Secretary of State for War. Under an Order of the County Council of Southampton, dated 14th August, 1893, given under the Local Government Act, 1888, this arrangement was altered: the number nominated by the Principal Secretary of State for War remains the same, but the number elected by the ratepayers has been increased to twelve. Thus the present Urban District Council of Aldershot consists of fifteen members, of which Mr. A. H. Smith, J.P., is the chairman. The military members are Colonel C. W. H. Douglas, A.A.G., Lieutenant-Colonel Pitt, R.E., and Surgeon-General O'Dwyer. M.D.

28. The *Medical Officer of Health* is John Shoolbraid, M.D., M.R.C.S., who was elected to the office in 1866. No part of his salary of £30 is repaid out of the county funds, and he is not under the Board's Order of March 23rd, 1891. Consequently he does not forward copies of his annual and special reports to the Local Government Board.

Dr. Shoolbraid does not devote all his time to the duties of his office, being likewise engaged in private practice. He has lived in Aldershot ever since it became a town.

29. The *Inspector of Nuisances* is Mr. John Butler. Salary, £104 per annum. Mr. Butler originally served in the army, and then in the police force. He was appointed Inspector of Nuisances in 1887. Recently he has begun the study of sanitary science with a view to obtaining a certificate.*

30. The *Surveyor* is Mr. Nelson Dennis. Salary, £225 per annum. Appointed November, 1897. Mr. Dennis is a member of

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* Since this Report was written I have learnt that Mr. Butler, and Mr. Watmore, who is an assistant in the Surveyor's Office, have both obtained such certificate.

the Sanitary Institute, and previous to his appointment at Aldershot he held the position of Surveyor and Waterworks Engineer, and was also Inspector of Nuisances, for the Urban District of Cowes, before which he worked in the office of the Borough Engineer at Stockton-on-Tees, where he subsequently became Engineering Assistant, and afterwards held a similar appointment under the Camberwell Vestry. He is a member of the Association of Municipal and County Engineers, a member of the Society of Architects, and an Associate Member of the Institution of Civil Engineers.

He came into office at Aldershot at a time when there were many arrears of work in his department, which he set himself resolutely and zealously to remove. His knowledge of sanitary work has been of great advantage to the district.

31. *Acts and Byelaws adopted.*

Acts.—The Urban District Council have adopted the following Acts, which came into force in the district on the dates placed against each :—

Act.	Date.
Public Health Act Amendment Act, 1890	23rd February, 1891.
Infectious Disease (Prevention) Act, 1890	25th March, 1891.
„ „ (Notification) Act, 1889	„ „ „

Byelaws.—The byelaws in force in the district, with their subject matters and dates of confirmation, are given in the following table :—

Byelaws.	Date.
Cleansing of footways, pavements, and cesspools ...	26th August, 1887.
New streets and buildings	„ „ „
New buildings	3rd January, 1896.
Common lodging houses	26th August, 1887.
Nuisances	„ „ „
Slaughter houses	„ „ „
A pleasure ground	„ „ „
The management of a mortuary	„ „ „
Offensive trades (blood boiler, blood dryer, bone boiler)	„ „ „
Hackney carriages	„ „ „
„ „	14th January, 1896.

32. *Regulations for* the management of *Dairies, Cowsheds, and Milk Shops* came into force in the district on the 3rd of May, 1887.

33. *Action taken in connexion with infectious disease.*—On the notification of a case of infectious disease, the Medical Officer of Health or the Inspector of Nuisances visits the house, and notice is given by these officers to the occupiers to remedy any defects which call for immediate treatment.

The case is reported to the next monthly meeting of the Sanitation Committee. This Committee issue the necessary statutory notice, on the report of their officers, directing compliance with the demands previously made.

This method of procedure has been in force for a little more than a year.

Since the end of January, 1898, information has been given by the Medical Officer of Health to the school attendance officer, who calls daily for the purpose, of every case of notified disease. If the patient be an attendant at school, or if children from the infected house attend school, the school attendance officer visits the school in question, and warns the schoolmaster or mistress. The children from the infected house are not allowed to attend school.

The District Council supply disinfectants to the occupiers of infected houses, as required, and undertake the duty of disinfection of premises free of charge. This disinfection consists of sulphur fumigation. They also issue a series of "suggestions for preventing the spread of infectious or contagious diseases."

Recently the District Council submitted to competent authority samples of "swabs" from the throats of certain children notified as suffering from diphtheria, and in most of such cases the diagnosis was confirmed on bacteriological examination.*

D.—THE "CAMP" IN ITS RELATION TO THE TOWN.

34. *General Sanitary Conditions of the Camp and Sanitary Administration so far as they have a bearing upon Prevention and Control of Diphtheria in the District.*—The Urban District of Aldershot comprises, as has been previously stated, within its boundary a large area of property vested in the War Department. The part thus included consists of the whole of the South Camp, which is bounded on the north by the Basingstoke Canal, and a small strip of the North Camp. The boundary line of the Urban District starting from Lynchford corner on the river Blackwater on the east, passes nearly due west, north of the Camp Sewage Farm, the Kennels, the cricket ground, and across the Queen's Parade to cross the Basingstoke Canal by Claycart Bridge. It thus happens that the portion of the North Camp which includes the Barracks (the Marlborough Lines), is outside the Aldershot Urban District. The Camp Sewage Farm, in the North Camp, is, however, included in the Aldershot Urban District.

The Military Isolation Hospital at Thornhill, to which all the patients in both North and South Camp as well as those from the camp at Pirbright and the Barracks at Woking suffering from infectious diseases are removed, is in the South Camp, and therefore in the Aldershot Urban District. It thus happens that the death-rates of the Farnborough Urban District, and of the districts in which the Camps at Pirbright, and the Barracks at

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* This procedure was also adopted by certain of the medical practitioners of the town, and one of them usually attached to his notification a telegram from the Clinical Research Society, to the effect that the diagnosis of diphtheria had been confirmed bacteriologically.

Woking are situated, are lessened at the expense of the Aldershot Urban District.

Enteric fever cases are treated in the wards of the General Hospitals, to wit, the Cambridge ("General") Hospital in the South Camp.

The Camp is divided into three main sets of "lines," of which the "Marlborough Lines" are entirely in the North Camp, and the "Stanhope Lines" and "Wellington Lines" are entirely in the South Camp. Of these the "Stanhope Lines" are placed between the "Marlborough Lines" and the "Wellington Lines," from the former of which they are separated by the Basingstoke Canal, and from the latter, roughly by the crest of a hill. The "Wellington Lines" extend down to the town of Aldershot.

Of these divisions of the Camp, the buildings in the "Wellington Lines" are the oldest. They are large Barracks built for the most part of ordinary brick.

The buildings in the "Stanhope" and "Marlborough Lines" have all been constructed during the past few years and are of red brick.

There are scarcely any of the old wooden huts now remaining which formed such a well-known feature of the Camp until quite recent years.

Camp Sanitary Administration.—The Principal Medical Officer is the Sanitary Officer for the Camp. Once in every year he makes a personal inspection of the Camp in minute detail. This is by no means the only inspection made by him, but it is a routine inspection; other inspections of particular portions of the Camp are made at his discretion and as required.

Of recent years he has received the assistance of a Medical Officer specially appointed as Assistant Sanitary Officer, who, in addition to making such special inspections as the Principal Medical Officer may depute to him, also has charge of the bacteriological and chemical laboratory attached to the Cambridge Hospital.

At the present time, the Principal Medical Officer is Surgeon-General O'Dwyer, M.D., and the Assistant Sanitary Officer is Captain Louis Hughes, Royal Army Medical Corps, who was the first officer appointed to the post, the date of the appointment being December, 1897.

Captain Hughes has made special study of bacteriology and is a diplomate in Public Health.

Reports on sanitary matters are made to the Principal Medical Officer by the various Medical Officers of the Camp. Each block or series of blocks of buildings is in the immediate charge for sanitary matters of a Medical Officer. It is this officer's duty to make a weekly detailed inspection of the block or blocks under his care, and to report any defect observed to the Principal Medical Officer and to the Officer Commanding the "Unit" concerned.

When a case of infectious disease occurs, the Medical Officer in charge of the quarters at once reports the fact to the Principal Medical Officer, and to the Officer Commanding the regiment or

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"Unit," and to the General Commanding the Brigade. He further makes investigation into the circumstances connected with the case, and furnishes a report thereon to the Principal Medical Officer. He superintends the disinfection of the premises, and reports to the Officer Commanding the "Unit" that the quarter is ready to be handed over to the Royal Engineers for white-washing or re-papering, as the case may be. When the Royal Engineers have completed this work they notify the fact to the Medical Officer in charge of the quarters, who, in his turn, notifies to the Officer Commanding the "Unit" and to the Principal Medical Officer that the quarters are ready for re-occupation.

As a matter of routine the Medical Officer in charge of the infected block invariably examines all the other persons in the married quarters or barrack room where the case has occurred. The entire family in the married quarters, all the inmates of a barrack room or ward, are, when an infectious case occurs, removed to other quarters; the children are withheld from attending school, and the soldier ceases to do duty. Any suspicious case is kept under observation for at least a week.

When a case of diphtheria has occurred in a particular Army School, the Medical Officer in charge of that school makes a frequent examination of the children attending it. This inspection has been made as often as daily when occasion seemed to demand it.

In 1897, when diphtheria was extremely prevalent in the Camp, the various Medical Officers examined every child resident in that part of the Camp which was affected.

The Army schoolmasters and schoolmistresses are instructed to direct the attention of their Medical Officer to any child which appears to be sick or ailing.

On discovering a case of infectious disease the Medical Officer concerned telegraphs to the Cambridge Hospital, with the result that one of two special ambulances is at once despatched to remove the patient to the Isolation Hospital; this ambulance is disinfected after each act of service. A special covered van, painted red, is sent to remove to the Isolation Hospital all such articles as bedding, clothes, &c., as are in the opinion of the Medical Officer in need of disinfection. When disinfected, such articles are returned in a special covered van painted white.

The furniture, flooring, and painted woodwork of the infected quarters, as far as practicable, are washed down with corrosive sublimate solution or a solution of chloride of lime, as the Medical Officer in charge may direct, and soap and water are freely used. Frequently there is practised fumigation by means of sulphur dioxide gas, but it is laid down that this is not to be relied upon in place of disinfection by other means. The windows of the infected room or rooms are kept open for as long a period as practicable. The ceilings are then whitewashed, and the walls distempered by the Royal Engineers. In the case of papered walls, the paper is stripped off, and the room re-papered.

As a routine practice the Army Schools are not disinfected on the occurrence of a case of infectious disease among the children, although such a course has now and again been undertaken; for instance, in 1897, when scarlatina became prevalent among the scholars of a particular school, the whole school building was disinfected.

Each school building is disinfected as a matter of routine during each vacation, when everything which it is possible to subject to soap and water is washed and scrubbed. The walls are distempered and the ceiling whitewashed, as may be required.

The diseases scheduled as infectious by the Medical Department of the War Office, and the full details of the administration, are contained in the regulations for the Army Medical Services, 1897.

The above account simply sets forth the administrative arrangements as practised in the Camps, when dealing with infectious disease generally.

In dealing with cases of diphtheria, precautions in addition to the above are observed.

On the arrival of the patient at the Isolation Hospital, the Medical Officer in charge takes a "swab" from the throat, nose, &c., and sends this immediately, with suitable precautions, to the Laboratory at the Cambridge Hospital. On the day of its receipt, cultures of the material are made, and the result is telegraphed the following day to the Medical Officer in Charge of the Isolation Hospital. Should the bacteriological examination prove negative in the first instance, the Medical Officer of the Isolation Hospital uses his own discretion as to forwarding further samples for examination. As a matter of fact, he generally does submit further "swabs," but the mere fact that there has been failure to isolate the diphtheria bacillus does not preclude him from entering the diagnosis as "diphtheria," and when once a case is diagnosed as diphtheria, whether by bacteriological examination or on clinical grounds, the patient is not allowed to leave the Isolation Hospital until repeated examinations of the throat secretions and nose discharge, during convalescence, have shown the bacillus to be absent. In the event of the bacillus being reported present, the Medical Officer of the Isolation Hospital has no option, but must enter the case as one of diphtheria.

The Military Isolation Hospital stands on the summit of Thornhill. Taking the circumstances of the Camp into consideration, this is probably the most isolated place that could have been selected. The buildings are surrounded by an open fence of iron spiked railings.

The hospital erected by the Royal Engineers is of red brick. It was opened on 1st August, 1896, and has been added to at intervals until at the present time there are two pavilions, each having two wards of six beds each; two pavilions of eight beds each; and two pavilions of four beds each; the total number of beds available being 48. There is an administration block, a small mortuary, a disinfection block, and a lodge in which the sergeant in charge resides—all separate buildings.

There is also a temporary building of wood, erected for a discharging block, having a bath-room in the centre, but no water supply has yet been laid on to it. This is to be replaced by a similar but permanent building of brick. There is, however, no

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laundry block, and no bathing accommodation has been provided for the female nursing staff.

The disinfecting apparatus is a Recks (Copenhagen) steam disinfector, and there are separate chambers for the infected and disinfected articles. There is also in the block a chamber for storing the uniforms, &c., of the patients after disinfection, as all soldiers in hospital wear special ward clothes.

This regulation *re* ward clothes applies to the orderlies of the Royal Army Medical Corps doing duty in the Isolation Hospital. They only wear the uniform of their corps when off duty outside the Isolation Hospital.

In dealing with infectious sickness no sharp distinction is drawn between the military and the civil population of the Camps. There are civilians resident in the Camps, such as canteen keepers, officers' servants, &c., and when any such, or their children, are attacked by infectious disease they are removed to the Military Isolation Hospital for the safety of the Camps, although they are not soldiers, nor "borne on the strength" of a regiment.

The wives and children of soldiers married without leave are not "borne on the strength," and are therefore civilians. These persons are not entitled to quarters, and reside outside the Camp, the soldier-husbands having in some instances a "sleeping-out pass." These families are not recognised in any official sense. Thus they are not entitled to medical attendance, but as a matter of grace on the part of the Medical Officers of the Army this attendance is freely and readily given if solicited. The Principal Medical Officer has power to permit medicines to be issued to them in suitable cases; but they are not admitted to the Military Isolation Hospital unless they happen to occupy Government quarters.

The same broad views are held as regards the Army Schools. The children of civilians resident in the Camps are permitted, by grace of the War Department, to attend the Camp Schools, and thus in many instances a long daily tramp to the Board Schools is obviated. Soldiers "married on the strength," for whom no "married quarters" can be furnished in the Camps, are either provided with hired quarters in the Town, where there are several houses in a particular street rented for the purpose, or they receive payment in lieu of quarters.

The children of such soldiers attend the Army Schools, or they may go to the Board Schools on obtaining permission to do so from the Military Authorities.

Army Schools.—These schools, being the property of the War Department, are administered under the "Army School Regulations, 1898," and the "Standing Orders for Inspectors of Army Schools, Examiners, and Teachers, 1899."

The Army Schools are attended by such of the soldiers who have not attained a certain standard of elementary education. Adults attend the same schools as the elder children, but at different hours. The following table gives the situation and number of the Army Schools in the Camps of Aldershot, with the number of adults and children carried on the books of such schools, in the month of January, 1899 :—

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TABLE showing the situation and number of the Army Schools in the Camps at Aldershot, with the number of Adults and Children on the books of such schools during the month of January, 1899.

Situation.	School.	Number of Scholars on the Books.		
		Adults, 15 years and upwards.	Elder Children, 8-14 years.	Infants, 3-8 years.
Wellington Lines—				
East Cavalry Barracks	No. 1 Garrison School...	96	60	—
Salamanca „	No. 2 „ „ ...	204	57	—
Royal Artillery „	No. 3 „ „ ...	53	69	—
West Cavalry „	Cavalry Brigade Infant School.	—	77	33
Salamanca „	3rd Brigade Infant School.	—	—	96
Royal Artillery „	Royal Artillery Infant School.	—	34	63
Stanhope Lines—				
Barossa Barracks ...	No. 4 Garrison School...	275	83	—
"East of St. George's Church."	No. 5 „ „ ...	270	205	—
South of "A" Square	1st Brigade Infant School	—	—	99
„ „ „	Model „ „	—	—	202
Barossa Barracks ...	1st Brigade Elder Girls' School.	—	94	—
Near Thornhill Terrace	2nd Battalion Northampton Infant School.	—	—	35
Marlborough Lines—				
Oudenarde Barracks ...	No. 6 Garrison School...	371	85	—
„ „ ...	2nd Brigade Infant School.	—	—	152
„ „ ...	2nd Brigade Elder Girls' School.	—	75	—
Total on School Books		1,269	839	680

E.—GENERAL CONSIDERATIONS ON THE PAST AND PRESENT PREVALENCE OF DIPHTHERIA AT ALDERSHOT.

35. *School Influence on Diphtheria in the Town.*—It has not been possible to ascertain for the Town, with any exactness, the schools attended by the children attacked by diphtheria; no record has been kept by the officers of the District Council with reference to these matters. An attempt has, however, been made to compile this record, but owing to the removals of families it is necessarily incomplete, and of certain cases which might prove the connecting links between separate series of attacks no record has been obtained. Of necessity also "notified" cases could alone be dealt with, there being no means of ascertaining what had been the relation, if any, with schools of throat illness not designated diphtheria.

So far as can be ascertained, there were certain children attacked during 1893 who were scholars at either the West or East End Board Schools, or at a certain private school.

In 1894 a school teacher at the National School was notified as suffering from diphtheria, and cases occurred among the scholars of the West and East End Board Schools, and one case in another private school.

In 1895, as far as the record goes, there was only one notified case among the scholars attending the West End Board School, two in private schools, some five cases in the East End Schools, and the North Lane Infant School had one case.

In 1896 there were cases notified among the scholars of the West End Schools at the beginning and end of the year, two private schools appear to have had cases, and there were several in the East End Schools.

In 1897, as far as the imperfect record shows, no case was notified among the scholars of any of the schools prior to May, except in the West End Schools, where some four occurred in the Infant School. The West End Schools will be referred to later on.

In May there was a single case notified in the East End Schools, probably in the Infant School; and, as far as these schools are concerned, there was a case in July, and no other cases till October.

In June a girl, aged 7 years, was notified as having diphtheria, and she was attending the St. Joseph's Roman Catholic School. This is the first case recorded as occurring among the scholars of that particular school. There was a case among the boys in July and another in August, but the age of one of these scholars was not ascertained, and there was a case among the infants in December. These appear to have been all the recognised cases among the scholars during 1897.

The North Lane School had one case notified among its scholars in August and another in September, the National School a single case in September, and there were three cases in two private schools.

The bulk of the children attending school who were known to be attacked during the year were scholars at one or other of the West End Board Schools. There appear to have been notified among the children of these schools the following cases:—

Month.	Infants.	Boys.	Girls.
June	1	—	—
July	4	1	—
August	1	—	—
September ...	3	1	1
October	1	—	2
November ...	3	2	1
December ...	2	—	3

In 1898 cases were notified among the scholars at one or other time in each of the Public Elementary Schools; and in the months of November and December all of these schools had cases among their scholars. The District Council, therefore, closed the schools on 13th December.

In 1899 three cases were notified in January, and one in February, at the Girls' School, and one in February at the Infant School of the West End Board Schools. There were three cases in the two months at St. Joseph's School, and one case in January at the National Infant School. At the East End Board Schools one case was notified in the Girls' School in January and another in February, and one in the Infants' School in January. Two cases are recorded as occurring in private schools.

On 13th February, 1899, the Infant Schools of the East End Board School and of the National School were closed by the School Authorities on account of the prevalence of measles. The notifications of diphtheria practically ceased at the same time, no case being notified between February 13th and 28th; by the latter date the schools had been re-opened.

Chart 5 in Addendum shows for both Town and Camps the varying periods during which the schools were closed during 1897 and 1898, and gives the number of notified diphtheria attacks week by week during those years, and of each case which proved fatal.

Table L in Addendum gives the known number of notified attacks by diphtheria occurring among the scholars of the various schools in the Town from 1st January, 1897, to 28th February, 1899.

As to means at school for facilitating spread of diphtheria; during my inspection of Aldershot Town each school was visited and inquiry made into certain matters, including the method in vogue for cleansing the slates used by the pupils. The answer to this query was practically the same at all the schools, and was to this effect: the schoolmaster or mistress had a mop or sponge attached to the end of a stick, which he or she dipped into water, and moistened the slate; the children, with a rag or wiper which they provided themselves, then cleaned the slate. This was the theory, but the practice would appear to be somewhat different, as on one occasion when a statement similar to that set forth above had just been completed by a teacher, another teacher in the schoolroom ordered a class of infants to clean their slates. This they proceeded to do by expectorating on, or licking the slates, and rubbing them with their rags. If a child had no rag it borrowed a neighbour's, and the rags themselves were moistened in similar manner to the slates.

Given a case of infectious sore throat it is easy to see how it might be spread by such methods as above described. Added to this is also the fact that the slates are the property of the school, and no child exclusively uses one slate.

The systematic inspection of the throats of children attending school with a view to eliminate all suspicious cases has never been attempted.

Inquiries were made as to disinfection as carried out at the schools, and they tended to show that disinfection was far from thorough, and in the case of the East End Board Schools most perfunctory.

36. *School Influence on Diphtheria in the Camps.*—It has been seen that among children the bulk of attacks by diphtheria since the beginning of the year 1897 fell upon those of the school attendance age.

On page 161 is given a list of the Army Schools. The children attend the schools in the Lines in which they live, and for the years 1897 and 1898 the bulk of the children known to be attacked by diphtheria were resident in the Stanhope Lines.

Chart 5 shows that in the year 1897, at a time when the Army Schools were closed for the summer holidays, in July, there were several cases of diphtheria in the Camps, and that the greater number occurred among children; in the same year, previous to this outbreak, there had been but few cases of diphtheria in the Camps, and of these cases only two were children, one child being attacked in the first week in February and the other in the third week in May. This matter will be referred to later.

In 1897, the attention of all the Army School masters and mistresses was directed to the danger of diphtheritic infection likely to be incurred by children in licking slates and pencils which were used in common, and arrangements were made for the slates to be moistened for cleansing purposes by those in charge of the schoolroom.

37. *The Influence of Infection spread from person to person* (a) *in the Town*, (b) *in the Camps.*—(a) *In the Town.*—There can be no doubt that the circumstances of many of the households invaded by diphtheria were such as to render isolation at home impossible, and the influence in the spread of diphtheria of the want of isolation of the sick cannot be disregarded. Throughout, up to the end of February, 1899, no cases had been treated in hospital. Many instances were observed in which a secondary case or cases had occurred in families where, if the first case had been effectively isolated, it would be reasonable to suppose that no such secondary cases would have occurred. The attacks appeared to have taken place to a great extent among those who, from their daily avocations, would the most readily be brought into contact with infected persons.

(b) *In the Camps* it was observed that children of different regiments to a great extent associate and play together in the immediate neighbourhood of their own barracks, and this to the exclusion of other children. They do not seem to visit the Town unless sent on messages or errands.

Nevertheless there is constant intercommunication between Town and Camps. Tradesmen visit the Camps, and the soldiers' wives come down to the Town to make purchases.

There are eight canteen managers in the Stanhope Lines, and it is worthy of note that cases of diphtheria occurred in the families of four of them. They are, as a class, by reason of their occupation, most frequently brought into business and social connexion with the townsmen.

It is no uncommon practice for the wives of soldiers married off the strength of the regiment, and in some instances for the elder children of such, to go into the Camps daily to act as nurses to the children of the Warrant and Non-Commissioned Officers. Again, soldiers married off the strength, whose wives live in lodgings in the town, are under no restrictions as to their quarters. Theoretically, they are required to report infectious sickness, but often they do not, and cases come under notice where not only the soldier returned nightly to his lodging when his children had diphtheria, but even slept in the same room with them.

There are many habits incidental to the soldier, both inside and outside of barracks, which render the transference from one to another of infectious sickness possible, but enough has been said to show that the Camps and the Town are in close relationship.

38. *General Considerations concerning the Town with reference to Diphtheria.*—As has been set forth under the sanitary circumstances of the district, the sewerage of the Town is imperfect, and the superficial soil polluted with organic filth through the keeping of animals. Many houses are damp, and many were built before the time at which the advantage of damp courses and concrete and cemented foundations was appreciated. These are conditions to be thought of as tending to lower the bodily vitality of the inhabitants, and to a corresponding extent their resistance to disease.

It is true that at some of the houses invaded by diphtheria the water supply was derived from surface wells, but no importance can be held to attach to the circumstance in so far as this disease is concerned.

As to how far the disease has been transmitted from man to the lower animals, and from them back to man, cannot be determined. Inquiry showed that in several instances fowls and ducks had been ill, died, or had been killed on account of illness. In one instance, a dog that had been the playmate of several children who suffered from diphtheria had been destroyed on the supposition that it had contracted "distemper." No veterinary surgeon was consulted as to the illness of this dog.

Inquiries made of the veterinary practitioners, showed that diphtheria had been recognised in dogs and cats, and these animals had been treated by them for that disease. In one locality, where diphtheria had occurred in several houses, certain cats were stated to have been "poisoned." Inquiry elicited the fact that a child had recently had a severe sore throat, recognised as diphtheria by the parents, but not so notified by the medical practitioner in attendance. During this child's illness she had been allowed to have a neighbour's cat to amuse her while in bed. This cat was the first of the series said to have been poisoned; the symptoms were difficulty of breathing and swallowing, and diarrhœa. A second cat in the same house died a few days after the first, with similar symptoms. A third cat, belonging to the next house, sickened while the other cats were ill, and ultimately died. The death took place the night before my visit to the locality, and I obtained possession of the carcase. Captain Hughes, R.A.M. Corps, kindly made a post-mortem examination on this cat; a congested patch was found at the posterior part of the pharynx, which on pressure yielded a yellowish exudation. Plate cultures made from this showed the presence of the Klebs-Loffleur bacillus. Owing to there being no arrangements at the laboratory of the Cambridge Hospital for control experiments on animals, the pathogenicity of the micro-organisms on guinea-pigs could not be put to the test—a fact which is to be regretted.

As regards the milk supply, in possible relation to the diphtheria, although none of the cowsheds visited were free from defect, no disease among the cows was ascertained to have existed. Much of the milk supply of the district is derived from outside the urban district. Several of the milk-sellers retail milk derived from one and the same farmer; in some instances the supply is derived from more than one source; when a milk-seller runs short he procures milk from another tradesman. Thus it follows that the name of the retailer is very little guide to the source of the milk; but, as far as could be ascertained, the persons attacked at or about the same time derived their milk supply from various sources. There was no instance in which many persons were suddenly and simultaneously attacked where the milk supply was served from a common source, as might be expected in the event of any particular milk supply becoming infected.

39. *Statistics of diphtheria mortality and attack in Aldershot Town and Camps.*—A study of the deaths registered in the Registration Sub-Districts of Farnborough and Farnham,* as having taken place in the Town and Camps of Aldershot over a period of years, shows that death by one or other form of throat sickness has not been absent any one year since 1876, beyond which year investigation has not been made.

It has been set forth previously in this Report that the North and South Camps are in different Registration Districts, and that the deaths from infectious disease for by far the greater part take place at the present time in the South Camp, in which is situated the Military Isolation Hospital. The population of the Camp is not a stationary one. The number of persons varies within considerable limits; but always adults are, in the Camps, relatively more numerous than children, as compared with civil population. The difficulty of estimating the population of the Town with any degree of accuracy is shown on page 141.

In broad and general comparison of the incidence of diphtheria mortality in Town and Camps, the fact must be borne in mind that at census periods, relatively to total population in each instance, children in the Town were three times more numerous than children in the Camps. In the case of disease like diphtheria, rarely fatal at ages over 15 years, the disproportion of children in Town and Camps becomes of importance from a statistical view point.

The following Table A gives, for the years 1876 to 1898 inclusive, the number of deaths by diphtheria and allied throat sickness recorded in the Farnham Registration Sub-District, and the Farnborough Registration Sub-District, as having occurred in the Town and Camps of Aldershot. The deaths are shown under certain age groups, viz.: 0–3 years (under the age for school attendance); 3–15 years (at school attendance age); and 15 years and upwards (persons in the main not attending school). The sex is given in each instance.

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* The latter was divided in 1897 into Registration Sub-Districts of Farnham and Aldershot.

TABLE A, showing for the years 1876 to 1898 the number of deaths by Sub-District as having occurred in the Town of Aldershot and in the as having occurred in the North Camp, Aldershot; and separating such

Year.	Deaths registered as due to Diphtheria and allied Throat Sickness													
	Town of Aldershot.									South Camp,				
	0-3 years.		3-15 years.		15 years and upwards.		Total.		Total both Sexes.	0-3 years.		3-15 years.		
	Sex.		Sex.		Sex.		Sex.			Sex.		Sex.		
	M.	F.	M.	F.	M.	F.	M.	F.		M.	F.	M.	F.	
1876 ..	—	—	1	—	—	—	1	—	1	1	1	—	1	
1877 ..	1	1	—	—	—	—	1	1	2	—	—	—	—	
1878 ..	1	—	1	—	—	—	2	—	2	1	1	1	—	
1879 ..	—	2	1	1	—	—	1	3	4	—	—	—	—	
1880 ..	—	—	—	—	2	1	2	1	3	—	1	—	—	
1881 ..	—	—	—	—	—	—	—	—	—	1	—	—	—	
1882 ..	5	1	3	2	2	—	10	3	13	1	..	—	—	
1883 ..	4	3	10	12	—	—	14	15	29	1	1	1	—	
1884 ..	10	4	11	12	—	—	21	16	37	—	—	1	1	
1885 ..	3	2	13	9	—	—	16	11	27	2	4	3	4	
1886 ..	2	3	4	6	—	—	6	9	15	1	1	1	2	
1887 ..	—	1	—	1	—	1	—	3	3	1	—	1	—	
1888 ..	2	1	2	1	—	—	4	2	6	1	—	—	1	
1889 ..	—	1	2	1	—	—	2	2	4	1	—	—	—	
1890 ..	2	2	—	—	—	—	2	2	4	—	1	—	1	
1891 ..	2	—	1	2	—	—	3	2	5	—	—	—	1	
1892 ..	—	—	1	1	—	—	1	1	2	—	—	—	—	
1893 ..	2	—	1	1	—	—	3	1	4	1	2	—	—	
1894 ..	3	3	5	1	1	—	9	4	13	1	1	—	1	
1895 ..	1	5	3	—	—	1	4	6	10	1	1	—	—	
1896 ..	2	1	3	3	—	—	5	4	9	—	1	1	1	
1897 ..	4	6	11	2	—	—	15*	8	23	—	—	3	2	
1898 ..	5	2	12	11	1	1	18	14	32	—	1	5	1	
Totals	49	38	85	66	6	4	140	108	248	14	16	17	16	
	87		151		10		248			30		33		
	238									63				

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* These figures do not tally with those given later on in the text; as then the cases are referred to their place of residence at the time of attack, and not to the place where death occurred. For instance, a soldier's child attacked in the Town and removed thence to the Military Isolation Hospital for treatment, and dying there, appears in the above table under the heading South Camp; whereas later in the text it would appear among the cases recorded as having their origin in the Town.

Diphtheria and allied Throat Sickness in the Farnham Registration
South Camp, Aldershot, and in the Farnborough Registration Sub-District
deaths into certain age groups, and allotting them to their respective sex :—

in the Town and Camps of Aldershot for the Period 1876 to 1898.

Aldershot.					North Camp, Aldershot.									Total number of Deaths registered as occurring in both Camps, Aldershot.
15 years and upwards.		Total.		Total both Sexes.	0–3 years.		3–15 years.		15 years and upwards.		Total.		Total both Sexes.	
Sex.		Sex.			Sex.		Sex.		Sex.		Sex.			
M.	F.	M.	F.		M.	F.	M.	F.	M.	F.	M.	F.		
—	-	1	2	3	2	—	—	—	—	—	2	—	2	5
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	2	1	3	—	—	—	—	—	—	—	—	—	3
—	—	—	—	—	—	—	—	—	1	—	1	—	1	1
—	—	—	1	1	—	—	—	—	—	—	—	—	—	1
—	—	1	—	1	—	—	—	—	—	—	—	—	—	1
—	—	1	—	1	—	—	1	--	—	—	1	—	1	2
1	—	3	1	4	—	—	—	—	1	—	1	—	1	5
2	—	3	1	4	—	—	—	1	—	—	—	1	1	5
1	—	6	8	14	—	—	—	—	—	—	—	—	—	14
—	—	2	3	5	—	—	—	—	1	—	1	—	1	6
1	—	3	—	3	—	—	—	—	—	—	—	—	—	3
—	—	1	1	2	1	—	—	—	1	—	2	—	2	4
1	—	2	—	2	—	—	1	—	—	—	1	—	1	3
3	—	3	2	5	—	—	1	—	1	—	2	—	2	7
—	—	—	1	1	1	—	—	—	—	—	1	—	1	2
—	—	—	—	—	2	—	1	5	—	—	3	5	8	8
—	—	1	2	3	—	—	—	—	—	—	—	—	—	3
—	—	1	2	3	—	—	—	1	1	—	1	1	2	5
1	—	2	1	3	2	2	2	2	—	—	4	4	8	11
1	—	2	2	4	1	—	4	2	—	—	5	2	7	11
2	—	5*	2	7	—	—	1	—	—	—	1	—	1	8
—	—	5	2	7	—	—	—	—	—	—	—	—	—	7
13	—	44	32	76	9	2	11	11	6	—	26	13	39	115
13		76			11		22		6		39			
					33									

NOTE.—The deaths from 1876–1885 inclusive for the Registration Sub-District of Farnham have been extracted from Dr. Turner's Report. For the Registration Sub-District of Farnborough, for the whole period 1876–1898, and for the Registration Sub-District of Farnham from 1886–1897, and thence onwards for the Registration Sub-District of Aldershot, the figures have been extracted from the local Registers. In every year quoted the number of deaths thus quoted include not only the deaths by "diphtheria," but by similar throat affections. Deaths among patients transferred from the Barracks at Woking and the Camp at Pirbright to the Military Isolation Hospital, South Camp, Aldershot, are not included.

Passing now to non-fatal diphtheria and allied throat illness, as previously stated the Infectious Disease (Notification) Act, 1889, was adopted by the Urban District Council in March, 1891, so that comparison of *attack rates* by diphtheria in Town and Camps is limited to recent years.

The following Table (Table B) gives for the Town and the Camps the number of cases of "diphtheria" and "membranous croup" coming under notice from 25th March, 1891, to the end of the year 1898. As regards the Town, certain cases are included which proved fatal without making appearance on the Notification Returns.

TABLE B, showing for the period 21st March, 1891, to the end of the year 1898, the known CASES of "diphtheria" and "membranous croup" in the Town and in both Camps at Aldershot.

Year.	Known CASES of "diphtheria" and "membranous croup" in the Town and in both Camps at Aldershot from 21st March, 1891, to 31st December, 1898.	
	Town.	Camps.
1891	9	6
1892	17	13
1893	17	15
1894	29	13
1895	36	454
1896	46	249
1897	126	67
1898	155	37

The population of the Town in 1891 at the Census was 12,641, and the estimated population in 1898 was 16,500. The population of both Camps in 1891 at the Census was 16,969, and the average population in 1898 was 19,455.

In the Camps the ages of those attacked by diphtheria and allied throat sickness have not always been recorded, while in the Town no record of the ages of certain persons attacked has been compiled; and the facts cannot now be ascertained.

It is, however, possible to deal with diphtheria in the Camps according as the attack by the disease has fallen on persons 0–15 years, and on persons over that age.

As regards the Town, if all the cases of which either an imperfect or no record exists be taken as occurring in children under 15 years, and the great bulk of such cases would appear to have been in children under that age, a comparison can be made between the attacks rates at the one and the other age in the Town and in the Camps; but it must be borne in mind that rates will for the Town show slightly higher for children and correspondingly lower for adults than really appertained to these age periods.

TABLE C, showing year by year, from 1891 to 1898, for the Town and Camps of Aldershot, the attack rates, by Diphtheria and allied Throat Sickness, per 1,000 of the estimated population, at all ages, and in the age groups of under 15 years of age and over 15 years of age :—

Year.	Town of Aldershot.									Both Camps, Aldershot.									Year.
	All Ages.			Age Group, 0-15 years.			Age Group, 15 years and upwards.			All Ages.			Age Group, 0-15 years.			Age Group, 15 years and upwards.			
	Population.	Number of known attacks.	Attack Rate per 1,000 of Population.	Estimated Population.	Number of known attacks.	Attack Rate per 1,000 of Population.	Estimated Population.	Number of known attacks.	Attack Rate per 1,000 of Population.	Average Population (Figures supplied by Military Authorities).	Number of known attacks.	Attack Rate per 1,000 of Population.	Average Population.	Number of known attacks.	Attack Rate per 1,000 of Population.	Average Population.	Number of known attacks.	Attack Rate per 1,000 of Population.	
1891 ..	12,641 Census ..	9	·71	4,840	8	1·65 }2·70	7,801	1	·13 }0·48	17,267	6	·35	1,823	5	2·74 }5·42	14,984	1	·07 }0·13	1891
1892 ..	13,192 Estimated	17	1·29	5,051	12	2·38	8,141	5	·61	18,374	13	·71	1,783	11	6·17	15,723	2	·13	1892
1893 ..	13,743 "	17	1·24	5,362	12	2·24	8,381	5	·60	18,099	15	·83	1,768	14	7·92	15,825	1	·06	1893
1894 ..	14,294 "	29	2·03	5,473	24	4·39	8,821	5	·57	18,484	13	·70	1,824	9	4·93	16,151	4	·25	1894
1895 ..	14,845 "	36	2·43	5,684	27	4·75	9,161	9	·98	19,522	454	23·26	2,001	51	25·49	17,024	403	23·67	1895
1896 ..	15,396 "	46	2·99	5,895	36	6·11	9,501	10	1·05	20,293	249	12·27	2,178	62	28·47	17,600	187	10·63	1896
1897 ..	15,947 "	126	7·90	6,106	116	19·00	9,841	10	1·02	20,579	68	3·30	2,156	51	23·65	17,887	17	·95	1897
1898 ..	16,500 "	155	9·39	6,317	143	22·64	10,183	12	1·18	19,895	37	1·86	1,999	33	16·51	17,417	4	·23	1898

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Table C sets forth for the years 1891 to 1898 the estimated population of the Town and the average population of both Camps, the number of known attacks by diphtheria and throat sickness during those years in each instance, and the attack rates per 1,000 of the populations respectively at all ages and at the age groups of "under 15 years" and "over 15 years" of age.

From this Table it is seen that the attack-rate per 1,000 of persons living at all ages was higher in the Town than in the Camps until the year 1895, when a remarkable outburst, sustained during many months, occurred in the Camps among adults as well as children; and that in 1897 and 1898, while the attack-rate at all ages was declining in the Camps, the attack-rate in the Town considerably increased, and became in excess of the corresponding rate for the Camps.

The attack-rates for the age period 0–15 year shows that the rate is higher for children in the Camps than for children in the Town, for each year recorded until 1898, and that the exceptionally large prevalence of the disease which occurred in 1895 in the Camps, although the bulk of the attacks fell upon adults, and those attacked were for the most part soldiers, nevertheless affected, in proportion to the numbers, even more seriously children under 15 years of age.

For the age group over 15 years it is seen that the attack-rate was much higher in the Town than in the Camps until the year 1895, when, owing to the great outburst in the Camps, the attack-rate there became for that year some 23 times greater than that of the Town. In 1896, the attack-rates in the Camps at ages over 15 years fell somewhat, but was maintained, nevertheless, at a point 10 times above that of the Town, whereas in 1897 the attack-rate in the Town at this age mounted above the corresponding rate for the Camps. In 1898, the rate at this age for the Town had further risen, while the corresponding rate for the Camp had sensibly decreased. These facts are graphically represented in Charts 1, 2, and 3.

Chart 4 in Addendum shows week by week for the years 1895 and 1896 the known cases of diphtheria and allied throat sickness occurring in the Town and Camps of Aldershot. It also distinguishes for the Camps the attacks of women and children from those occurring in soldiers, and the cases of the North Camp from those of the South.

Chart 5 in Addendum shows week by week, from 1st January, 1897, to 28th February, 1899, information similar to that set forth in Chart 4. In addition, it represents the cases which proved fatal in both Town and Camps, and the approximate periods during which the army schools and the schools of the Town were opened or closed for holidays, &c.

Dealing now with the epidemic prevalence of diphtheria which commenced in 1895, it has been possible to note the behaviour of the disease month by month for a series of years, and to go on to

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scrutinise more closely than has yet been done its incidence on one and another section of population in Town and in the "Camps."

The following Table (Table D) shows month by month the known cases of diphtheria and similar throat sickness which occurred during the years 1895 to 1898 inclusive, in both Town and Camps.

TABLE D.*

Year.	Locality.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
1895	Town†	6	6	—	1	2	5	4	—	4	1	6	1	36
	Camps‡	5	2	1	1	7	16	70	55	81	112	76	28	454
1896	Town†	4	6	2	1	1	6	5	1	5	6	4	5	46
	Camps‡	18	30	27	36	38	21	31	30	9	1	6	2	249
1897	Town†	8	6	2	9	1	5	15	13	22	14	15	16	126
	Camps§	1	2	—	—	4	—	9	13	14	12	6	7	68
1898	Town†	18	26	15	7	10	7	2	3	2	3	29	33	155
	Camps§	3	2	—	—	—	1	2	5	5	3	10	6	37

* Aldershot being a military centre receives into its Military Isolation Hospital the cases of infectious disease which occur in the Barracks at Woking, the Camp at Pirbright, as already stated, and such cases as occur among troops in its neighbourhood on the line of march, in changing barracks, &c. Such cases not having their origin in the Camps of Aldershot are in all cases eliminated from this report. Also where cases of diphtheria have occurred in the families of soldiers resident in the Town, and were notified there (and appear to have been contracted in the Town), they have been in Table D included in the Town list of cases, even though they have been removed to the Military Isolation Hospital for treatment, and have in instances died there.

† In the Town the cases are given under the calendar month in which they occurred for each year here shown.

‡ The cases are given in the Official Returns, which are compiled from Friday to Friday, as occurring in the 1st, 2nd, 3rd, &c., &c., week of the year, and therefore are only approximately correct as to the exact month under which they are entered in this Table as far as regards the years 1895 and 1896.

§ For the years 1897 and 1898 the cases recorded are shown as they occurred in each calendar month in the Camps.

Table D illustrates the sudden development of epidemic diphtheria and throat illness which seized on the soldiers and their children in 1895. In the Camps, in the month of June of that year, the number of attacks began to rise rapidly and a remarkable outburst of throat sickness took place, which only faded out when the troops from the Camps moved out to participate in the manœuvres in the New Forest, which commenced 14 to 15 months later, on 19th August, 1896.

It is worthy of note that the great incidence of the disease in 1895 fell upon the soldiers, and also that the women and children in the South Camp suffered at this time much more severely than the women and children in the North Camp. The number of attacks recorded among the men is about equal in each Camp, but it must be borne in mind that the number of men in the North Camp is less than half the number in the South Camp, and that the incidence of the disease on men was more than twice as great

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in the North Camp than in the South Camp, as the following Table (Table E) for the year 1895 sets forth :—

Table E, showing for the year 1895 the number of men, women, and children attacked by throat sickness in the North and South Camps respectively :—

—	South Camp, Stanhope and Wellington Lines.	North Camp, Marlborough Lines.
Men	191	204
Women	8	—
Children	48	3
Total ..	247	207

Of this large number of certified diphtheria cases only one, man and six children died, the disease being reported as extremely mild in character. Nevertheless, the local death registers refer four deaths, in addition to those mentioned above, to sickness allied to diphtheria, and these were all deaths of children.

What were the conditions mainly conducing to the sudden epidemicity of diphtheria in the Camps in 1895, to its maintenance there in epidemic form during 1896, and to its seeming transference as an epidemic from the Camps to the Town during 1897, cannot now be determined. Too many of the data essential for a definite judgment on the subject are unrecorded, and cannot after lapse of several years be recovered. All that remains to be done is to contrast the behaviour of the disease in recent years, 1897, 1898, and early 1899, of diphtheria in Camp and Town, with a view of ascertaining, if it be possible, what have been the agencies mainly responsible since 1896 for maintenance and spread of the disease in the one and the other locality.

And, first, as regards diphtheria mortality :—

Diphtheria Deaths in the Town in 1897–99.—On the basis of the Census data for the South Camp and Town for 1891, the estimated total population for the Town in 1898 comprised persons at ages as follows :—

0 to 3 years	1,697
3 „ 15 „	4,621
Over 15 „	10,182
Total	16,500

These numbers, checked against the actual number of children attending the Public Elementary Schools, would tend to show that the number as estimated is above the actual number of children living in Aldershot, even when allowance has been made for children between 13 and 15 years of age (13 years being the school limit for compulsory attendance), and for the number attending the private schools. The rates derived from using these figures will, in consequence, always tend rather to understate than overstate the amount of diphtheria which has prevailed among children.

From Table J in Addendum Table F has been constructed, showing for the Town of Aldershot the mean annual diphtheria death-rate per 1,000 living at each of several age groups, for each sex, in the period 1st January, 1897, to 28th February, 1899.

TABLE F, showing for the period 1st January, 1897, to 28th February, 1899, the Annual Diphtheria Death-rate per 1,000 persons living at each age group, and for both sexes, in the Town of Aldershot:—

Age Groups.	Number of Diphtheria Deaths.			Reduced to Annual Diphtheria Death Rates per 1,000 living at each Age Group.		
	Males.	Females.	Both Sexes.	Males.	Females.	Both Sexes.
Under 3 years ...	8	9	17	4·35	4·89	4·62
3 to 15 " ...	23	17	40	4·59	3·40	3·99
Over 15 " ...	1	2	3	0·09	0·18	0·14
Totals, at all ages	32	28	60	1·81	1·55	1·68

From this Table it is seen that although in the Town the mortality rate from diphtheria in children 0–13 years exceeded that in children 3–15 years, yet children of school attendance age furnished by far the larger proportion of diphtheria deaths.

Diphtheria Deaths in the Camp in 1897–99.—It has not been found possible, as regards diphtheria in 1897, 1898, and 1899, to construct for the Addendum a table for the Camps similar to Table J given for the Town, owing to the fact that the sex of children and infants has not always been recorded in the official returns. A table (Table K) has, however, been constructed, in which the cases occurring among children under 15 years have been referred to their age groups, and over that age to their respective sex. But as regards such cases as have ended fatally, the missing data have in each instance been extracted from the local death registers. Thus, for comparison with Table F for the Town, a similar table (Table G) for the Camps has been constructed, showing the annual diphtheria death-rate per 1,000 living at each age group and of each sex.

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TABLE G, showing for the period 1st January, 1897, to 28th February, 1899, the Annual Diphtheria Death-rate per 1,000 Persons living, and for both Sexes, in the Camps of Aldershot.*

Age Groups.	Number of Diphtheria Deaths.			Reduced to an Annual Diphtheria Death-rate per 1,000 living at each Age Group.		
	Males.	Females.	Both Sexes.	Males.	Females.	Both Sexes.
Under 3 years ...	—	1	1	—	1·60	0·80
3 to 15 „ ...	8	7	15	4·74	4·15	4·45
Over 15 „ ...	2	—	2	0·06	—	0·05
Total ...	10	8	18	0·26	1·55	0·42

From Table G it is seen that in the Camps, since 1896, children of school attendance age have not only the highest diphtheria

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* In Aldershot Camps the average strength for the years 1897 and 1898 was as follows:—

Year.	—	Men.	Women.	Children.
1897	South Camp	11,513	1,043	1,722
	North „	5,070	261	434
	Total	16,583	1,304	2,156
1898	South Camp	11,299	1,007	1,588
	North „	4,825	311	525
	Total	16,124	1,318	2,113
Average for the two years		16,353	1,316	2,134

At the Census of 1891, the proportion of children living in the age period 0-3 years, bore to the children 3-15 years the proportion of 1 : 2·7, and the numbers were equally divided between males and females. Therefore—

Children 0-3 years = 288·5 males and 288·5 females; and
„ 3-15 „ = 778·5 „ „ 778·5 „

In all official returns of the Camps the numbers of non-commissioned officers and private soldiers only are returned as "men," the "officers" not being included. The number of officers in the Camps varies between 500 and 600.

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death-rate of the age groups recorded, but that this rate is higher than the corresponding rate for the Town. For the other age groups diphtheria death-rates for the Camps are lower than the corresponding rates for the Town.

Secondly, as regards diphtheria attack :—

Diphtheria Attacks in the Town in 1897–99.—From Table J in Addendum* the ATTACKS of recognised diphtheria in the Town, which can be referred to their age groups and sex, furnish (Table H) the following figures as a *Mean Annual Attack-rate* calculated from 1st January, 1897, to 28th February, 1899.

TABLE H, showing for the period 1st January, 1897, to 28th February, 1899, the Annual Diphtheria *Attack-rate* per 1,000 persons living in each Age Group, and for both Sexes, in the Town of Aldershot.

Age Groups.	Cases of known Diphtheria or Membranous Croup.			Reduced to Annual Attack-rates per 1,000 living at each Age Group.		
	Males.	Females.	Both Sexes.	Males.	Females.	Both Sexes.
0 to 3 years ...	24	27	51	13·28	14·94	14·11
3 to 15 „ ...	100	104	204	20·31	21·13	20·72
Over 15 „ ...	11	19	30	1·01	1·75	1·38
Total, all ages...	135	150	285	7·68	8·53	8·11

The table shows that of the known diphtheria cases, not only did the greatest number occur in children of school attendance age, but that the attack-rate was greatest at that age. On the whole, and at each group of ages, females suffered more than males.

Diphtheria Attacks in the Camps in 1897–99.—From Table K in the Addendum* giving the ATTACKS of recognised diphtheria in the Camps, a table (Table I) has been prepared to show the *Mean Annual Attack-rate* per 1,000 persons for the period 1st January, 1897, to 28th February, 1899. For the reason already stated, it has not been possible to allot the cases under 15 years of age to their respective sex and age groups.

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* Not reproduced here.

App. A. No. 10.

On Sanitary Circumstances and Administration of Aldershot, and on Diphtheria therein; by Dr. Reece.

TABLE I, showing for the period 1st January, 1897, to 28th February, 1899, the mean Annual Diphtheria *Attack-rate* per 1,000 persons living in each age group, and for both sexes over 15 years of age, in the Camps of Aldershot.

Age Groups.	Cases of known Diphtheria or Membranous Croup.			Reduced to an Annual Attack-rate per 1,000 living at each Age Group recorded.		
	Males.	Females.	Both Sexes.	Males.	Females.	Both Sexes.
0 to 3 years ...	—	—	15	—	—	12·00
3 to 15 „ ...	—	—	75	—	—	22·23
Over 15 „ ...	21	2	23	0·59	0·70	0·60
Total, all ages...	—	—	113	—	—	2·63

This table shows, for so far as it goes, that during the period in question the attack-rate was less in the Camps than in the Town, in every instance except that for children of school attendance age, in which case it was somewhat greater in the Camps than in the Town.

40. *Considerations on, and Comparision of, the Sanitary Administration in the Town and in the Camps with reference to Diphtheria prevalence.*—Surgeon-General O'Dwyer became Principal Medical Officer in September, 1896. Sanitary administration forms only one item of the many duties of the "Principal Medical Officer," and Surgeon-General O'Dwyer received assistance to enable him to deal more effectively with such matters by the appointment of Captain Hughes in 1897.

Also, in 1896, the Military Isolation Hospital had been erected in the South Camp, and additional ward accommodation was from time to time provided there; a Recks steam disinfector added. A small analytical laboratory, which has existed for some years, was in January, 1898, efficiently equipped for bacteriological work at the Cambridge Hospital, and this enabled the method of dealing with infectious disease, and especially with diphtheria, to be further elaborated.

It is of interest to note that the attack-rate for the Camps recorded for each age group during the year 1898 is in every instance less than the corresponding rates shown for the Town; nevertheless, they are in every instance higher than the mean attack-rates for the Camp during the period 1891–94, *i.e.*, antecedent to the great outburst of 1895. It is also to be noted that the decrease of diphtheria in the Camps has to a very great extent taken place in persons over the age of childhood, and that children in the Camps show for the year 1898 an attack-rate three times as great as the mean attack-rate for 1891–94 for the corresponding age period.

In the Town there was no isolation accommodation, disinfection was perfunctory, and the District Council, strengthened by the presence of Surgeon-General O'Dwyer as one of the members nominated by the Secretary of State for War, was only beginning to deal with cases of infectious disease in a comprehensive manner at a time when the attack-rate per 1,000 of the whole population by diphtheria had been steadily rising for six years, and had reached a rate of 2·99 per 1,000 in 1896: the mean rate for the six years 1891 to 1896 being 1·78. In 1897 the rate rose suddenly to 7·90 per 1,000, and in 1898 further increased to 9·39. As has been already observed, it would seem that the great outburst of 1895–96 in the Camps had in some sense had its sequel in the Town.

It is impossible to state what, in the Camps, was the respective share towards the lessening of diphtheria prevalence in 1896 exercised by the careful revision of preventive measures and by the movement of the troops from the Camps to the autumn manœuvres. The fact remains that diphtheria practically ceased among the soldiers, although it continued to attack their children.

It has been noted that a small outbreak of diphtheria occurred among the Army children at a time when the Army Schools were closed for the summer vacation (section 37 of this Report). I am informed that the Army Medical Officers are of opinion that, as a preventive measure against the spread of an infectious disease, such as diphtheria, the efficacy of school closure in limiting outbreaks of infectious disease among the civil population fails when applied to Army Schools.

The autocratic power possessed by the military authorities in dealing with infected quarters and their occupants can never be possessed by the civil power. It, however, remains to be seen whether, by prompt recognition and notification of cases of diphtheria, the immediate isolation of such sick in the Isolation Hospital as cannot be effectively isolated in their own homes, the free use of a reliable disinfecting apparatus, the more efficient disinfection of invaded houses, and perhaps an increase or alteration in the sanitary staff, the Town will not be able to limit, if not eradicate, the prevalent diphtheria.

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On Sanitary Circumstances and Administration of Aldershot, and on Diphtheria therein; by Dr. Reece.

TABLE L.—Showing the number of attacks by diphtheria occurring among the Scholars of the various Schools in the Town during the period 1st January, 1897, to 28th February, 1899.

Number of Children on the Books 27th January, 1899.	West End Board.			St. Joseph's.		National.		East End Board.			North Lane.	Private School.	School age but not attending School.	Under School age.	Over School age.	Not sufficient detail to classify.	Total.
	Boys.	Girls.	Infants.	Mixed.	Infants.	Mixed.	Infants.	Boys.	Girls.	Infants.	Infants.						
	580	340	380	214	89	140	87	332	325	350	108	?					
1897.																	
January	—	—	—	—	—	—	—	—	—	1	—	—	1	3	1	—	6
February	—	—	2	—	—	—	—	—	—	—	—	—	1	1	1	1	6
March	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	2
April	—	1	3	—	—	—	—	—	—	—	—	—	1	3	—	1	9
May	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1
June	—	—	1	1	—	—	—	—	—	—	—	—	1	1	1	1	6
July	—	—	4	1	—	—	—	—	—	1	—	—	—	3	1	4	14
August	2	—	1	—	—	—	—	—	—	—	1	—	1	6	1	2	14
September ..	1	1	4	—	—	—	1	1	—	—	1	1	3	4	3	2	22
October	—	2	1	—	—	—	—	1	—	3	—	—	2	3	1	—	13
November ..	3	1	3	—	—	—	—	—	2	1	—	—	1	—	—	4	15
December ..	—	4	2	—	1	—	—	—	—	—	—	2	2	3	1	1	16
Total	6	9	21	2	1	—	1	2	2	7	2	3	15	27	10	16	124
1898.																	
January	—	—	—	1	—	—	—	1	2	1	—	2	4	4	1	2	18
February	—	4	1	—	—	1	3	—	—	—	—	3	2	3	3	6	26
March	—	1	1	—	1	2	1	1	—	—	—	—	3	3	1	1	15
April	1	—	—	—	—	—	—	—	—	2	—	1	2	—	—	1	7
May	—	—	—	—	—	—	1	1	3	1	—	—	—	1	1	2	10
June	—	—	—	—	2	—	1	—	—	1	—	—	1	2	—	—	7
July	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	2
August	—	—	—	—	—	—	—	—	—	—	2	—	—	—	1	—	3
September ..	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	2
October	—	—	1	1	—	—	—	—	—	—	—	—	2	1	—	—	5
November ..	—	—	—	7	9	3	2	4	—	2	2	—	1	3	3	3	39
December ..	1	2	2	2	2	—	—	1	1	2	—	1	4	2	1	—	21
Total	2	7	5	11	14	6	8	8	7	9	4	7	20	20	12	15	155
1899.																	
January	—	3	—	1	1	—	1	—	1	1	—	1	3	1	7	—	20
February	—	1	1	1	—	—	—	—	1	—	—	1	2	1	—	—	8
Total .. .	—	4	1	2	1	—	1	—	2	1	—	2	5	2	7	—	28

No. 11.

REPORT upon EPIDEMIC ENTERIC FEVER in the Borough of FALMOUTH; by Dr. G. S. BUCHANAN.

APP. A, No. 11.

On Enteric Fever in Falmouth; by Dr. Buchanan.

ON August 8th, 1899, the Local Government Board learnt from Dr. Bullmore, Medical Officer of Health of Falmouth, that since the beginning of the year enteric fever had been increasingly prevalent in that borough. A fortnight later they received a petition from 59 inhabitants and ratepayers of Falmouth for local inquiry into diverse insanitary conditions stated to exist in the place, and in particular into certain alleged deficiencies in quality and in quantity of the water supplied by the Falmouth Waterworks Company. As regards water supply, similar representations were made to the Board by numerous inhabitants of the Borough of Penryn, which is served by the same Company's waterworks.

In these circumstances the Board instructed me to make inquiry into the local prevalence of enteric fever and into the general sanitary circumstances of Falmouth. I visited the borough on September 12th and at subsequent dates.

PART I.—DESCRIPTION AND SANITARY CONDITIONS.

The limits of the Borough of Falmouth were determined by the Borough of Falmouth Extension Order, 1892, by which were amalgamated—

———	Land Area.	Inhabited Houses, 1891.
"Old Borough" of Falmouth	49 acres.	559
"Falmouth Parish"	657 ,,	1,202
"Budock Urban Parish"	151 ,,	189
Present Borough of Falmouth	857 acres.	1,950

The total number of inhabited houses is now reckoned (from the "Falmouth Directory") at 2,330. On the basis of the last census, the population of the area comprised in the present borough is estimated to have been 12,217 in 1891. This figure, however, includes 1,168 persons afloat on 16,000 acres of water in Falmouth Harbour which are within the borough boundaries. The Medical Officer of Health has not been able to compute the present shore population, but it may be thought of as about 12,000.

Falmouth is built upon a tongue of land, projecting eastward, and ending at Pendennis Point, on the west side of the opening of the broad inlet of the English Channel known as Carrick Roads. The southern and south-eastern edges of this tongue of land face the open sea of Falmouth Bay; its northern and north-eastern margins enclose Falmouth Harbour. This harbour opens on the east to Carrick Roads, and to the north-west is continued up to the town of Penryn, three miles away, by a broad tidal channel known as Penryn River.

The greater part of the borough is spread out crescent-wise upon, and at the foot of, the slopes facing the harbour; but a newer "residential" portion lies over the crest of these slopes and looks on to Falmouth Bay. From the higher parts of the town, which are from 150 to 190 feet above Ordnance Datum, there is a steep fall to the north-east towards the harbour, and to the north-west towards the valley of "the Moor," which cuts through the town to reach the harbour at Market Strand, the centre of the "old borough."

The geological formation is Devonian, and consists of alternations of slatey beds with others more or less sandy. The strata have everywhere cleaved, and in addition they have been minutely folded and faulted. The beds have (though not constantly) a general dip to the south-east. But the mass of slatey rock is traversed by innumerable small faults, fissures, and joints, which allow ready transmission of underground water in directions other than that of the general dip. Springs occur frequently along these faults and fissures.

The soil formed from the decomposition of the slatey rock is a sandy, somewhat stony, clay, which in the "Moor" valley is probably more of the nature of a thin alluvial deposit.

The shipping trade of Falmouth is now much smaller than in former times, and comparatively few cargoes are landed. Falmouth remains, however, an important "port of call," where vessels, principally sailing ships, put in for orders. Some ship-repairing is done, and there is a considerable iron foundry, employing some 300 men and boys, at the docks; otherwise there are few manufactures of importance. The town is frequented by summer visitors and yachtsmen, and many residents let lodgings. Of late, owing to the mildness of its climate, Falmouth has obtained some popularity as a winter "health resort," and the number of houses of the better class has materially increased during the last few years.

Streets, Dwellings, and House Accommodation.—There are about 12 miles of dedicated and about three miles of undedicated highroad in the borough. In the older part of the town streets are conspicuously narrow. Roadways are generally of macadam, and in satisfactory condition, but here and there, particularly in certain private streets, the surface of roads appears badly laid and uneven. Considerable lengths of footway have been flagged by the Town Council within the last few years.

In many places dwellings are closely aggregated upon area. Such aggregation is most noticeable along and near to the main thoroughfares of the older part of Falmouth, where the houses and shops have little if any open space belonging to them.

Abutting on the backs of houses in these main thoroughfares is a series of small courts, closely packed one against the other, each court consisting of some dozen houses built on either side of a small yard, the only approach to which is a narrow passage from the main street. Open space about dwellings in certain small thoroughfares is often similarly restricted—Quay Hill and a conglomeration of dwellings at the junction of Swanpool Street and New Street are instances in point. In the higher parts of Falmouth, where the houses are by comparison newer, some open yard space or garden has usually been provided in rear of each dwelling. In the case of dwellings erected after 1867, the date of Town Council's present bye-laws for new streets and buildings, the amount of such open space usually complies with the requirements of the bye-laws. But not invariably; for example, cottages now in course of erection at Hall's Lane fail in this respect.

Most dwellings in Falmouth are built of local stone, generally faced with cement or stucco, or periodically whitewashed. A few houses are of wood, sometimes faced with slate, and here and there are old dwellings with clay walls. Houses are not seldom damp: in certain places their backs are built against the hillside, and thus dampness is augmented. The Town Council's bye-laws do not require sites of new buildings to be covered with concrete, or walls to have damp-proof courses. The latter, however, appear to have generally been provided in recently-erected buildings.

Dwellings in the courts and older streets of Falmouth are often without means of through ventilation. Some houses (*e.g.*, in Smithwick Hill) consist of two dwellings: one, entered from an upper street, superimposed on another, entered in the opposite direction from a lower level. In these cases the lower dwelling, with its back wall against a cliff, is unwholesome both by reason of damp and of lack of air. In a few instances (*e.g.*, houses in Snow's Court) there are no gutters to the eaves, and frequently down spouting is defective. Often yards are unevenly paved with "kidney" cobbles, and their guttering is faulty. Where this is the case rain-water and slop-water are apt to accumulate in the vicinity of dwellings.

In the older part of the town numerous houses are subdivided into tenements, in which overcrowding of persons now and again occurs. New dwellings suitable for workmen of the better class seem in some demand; several streets of small houses of this sort have recently been constructed, both on the estate of the Earl of Kimberley, which comprises a large portion of the borough, and elsewhere by builders as a speculation.

Sewerage.—The greater part of the town was sewered by the Falmouth United District Sewerage Board, which had jurisdiction in the "old borough" and in "Falmouth parish." The functions of this Board were transferred to the Town Council when the borough was extended in 1892. Most of the sewers were laid from 20 to 30 years ago, when two systems of sewers were provided, for each of which there is a separate outfall to the harbour. Sewers then laid down in general have ample gradient; for the most part they consist of glazed stoneware socketed pipes, with [illegible] Penryn, and the Parishes of Budock and [illegible]. The [illegible] supply however is, with a very few [illegible] to the Boroughs of Falmouth and Penryn.

Mr. [illegible] [illegible]

[illegible]

fe[illegible] ho[illegible] had seri[illegible] com[illegible] desc[illegible] sink enter[illegible] open[illegible]

As water the d[illegible] concr[illegible] sewer a nei[illegible] instan[illegible] where und[illegible] (*e.g.* drai[illegible] mor[illegible] brea[illegible] such[illegible]

[illegible]

its area is about 1¼ acres, and its estimated capacity when full 2½ million gallons.

Penryn and the lower part of Falmouth can be supplied by gravitation from any of the "low-level" reservoirs; at present the low-level main, which serves both places, has its inlet from the clear water pool of "Number 3" reservoir. The higher part of Falmouth (comprising 1,063 houses out of the total 2,024 supplied from the waterworks) receives its water from the high service reservoir by gravitation through a high-level main. No part of the water area is directly supplied from the main reservoir.

GATHERING GROUND.—The main reservoir, which receives all water derived from the gathering ground, is fed partly by a few streamlets along its margin, but mainly by Mabe Stream, which enters at the south-west.

The tops of hills on the gathering area are, as a rule, somewhat flat. The slopes to the streams on the whole are gentle, but in several places they are steep. The area for the most part is good pasture land: it also comprises some disused quarries and considerable patches of waste ground. The soil is granite. Generally the rock is close below the surface, covered by a thin layer of quartz sand and surface loam. Scarcely any peat is met with on the hill sides.

There are numerous small springs on the gathering ground, no doubt determined by joints and fissures in the granite. These springs furnish practically the whole of the water which reaches Mabe Stream and its tributaries in dry seasons. After any considerable period of drought they are apt to fail; at the date of my visit in September, the end of a long dry summer, scarcely any water had been reaching the reservoirs for several weeks.

Alluvium, often covered with a surface of thin peat, is found along the valleys. The floor of the main reservoir is a natural flat consisting of alluvial, granitic, clay overlying the granite, which here and there comes through to the surface. This reservoir, though of large area, is everywhere shallow, and its shallowness is increased by copious growth of rushes and other water plants in its floor. At the date of my visit a large portion—perhaps one-half—of the total area of the reservoir was not covered by water, and along much of the exposed floor it was evident that a covering of thin peat was in course of formation. The bottom of the three smaller reservoirs below the main reservoir is also alluvial clay; their depth, however, is somewhat greater.

There are upon the gathering area some 70 dwellings comprised in the small hamlets of Mabe Burnthouse, Treverva, and Longdown, as well as a few scattered farms and groups of cottages.

Potential sources of dangerous Pollution on the Gathering Area.—(1) From manure on the land:—Most of the pasture land bordering the main reservoir, Mabe Stream, and its tributaries is from time to time manured. In some instances I noticed considerable deposits of manure alongside the banks of streams; in other cases manure was lying on sharply sloping land in positions where a heavy shower could hardly fail to carry polluting matter

hamlet to Longdown Stream is sharp. Open channels in the village receive overflows of several capacious open privy middens, drains of stables, and the slop water of nearly all the houses. These channels pass to a field ditch, which runs a short distance along the contour of the slope and then falls into the stream. At the end of September there was no water in this ditch, but there can be no doubt that heavy rainfall would be likely to wash down into Longdown Stream polluting matters derived from Treverva.

Recently representations with regard to the state of the gathering area have been made to the Council of the East Kerrier Rural District, both by Dr. Blamey, Medical Officer of Health of that district and of Penryn, and by Mr. Cox, on behalf of the waterworks company; and I was informed that in certain cases action designed to prevent dangerous pollution of Mabe Stream and its tributaries was about to be taken. However this may be, it is evident that in order properly to safeguard the purity of water derived from this gathering ground, systematic inspection can hardly be dispensed with. No such inspection, however, is made by the officials of the waterworks company. The waterworks company own only some eleven acres out of the total gathering area.

FILTRATION.—At the end of 1898 a sand filter was interposed in the chain of "low-level" reservoirs below the main reservoir, and for this purpose "Number 3" reservoir was divided into an upper and a lower pool by a dam. A portion, 30 feet by 140 feet, of the floor of the upper pool was excavated about 3 feet, and the excavated space was filled up, much as in an ordinary filter bed, by a bottom layer of broken rock a foot thick, covered by 2 feet of sand. Below the broken rock were laid perforated pipes, provided with ventilating shafts, which deliver their contents to two collecting pipes which traverse the dam and form the inlets to the lower pool of Number 3 reservoir, which thus acts as a clear water pool.

This filtering arrangement hardly contrasts favourably with those of most modern waterworks. Before the surface of the filter can be scraped or remade, all water from the main reservoir has to be shut off from the supply. Next, several days must elapse so as to allow the consumption of water in Falmouth and Penryn to reduce the water level in the lower reservoirs until the floor of the upper pool of "Number 3" and the surface of the filter are exposed. Then, owing to the need for replenishing the supply from the main reservoir, the filter-cleansing operations are got through in a few hours, with the result that the sand bed is neither rested, aerated, nor matured before being again taken into use. There is no provision for excluding from the supply the first washings of the filter after it has been scraped or remade.

I visited the waterworks when the filter was being scraped after a period of nearly two months continuous use. Notwithstanding this interval, and the peaty character of the water which had been filtered, the accumulation of scum on the surface had been comparatively slight—a circumstance which suggested that "streaming" might have been taking place along the walls or through the body of the filter. I could obtain no data by which the average rate, or the range of rates, of filtration could be approximately estimated.

Water thus filtered passes (*a*) from Number 3 clear water pool to the low-level main supplying Penryn and Falmouth, and (*b*) to Number 2, and thence to Number 1 reservoir, from which it is pumped up to the high-service reservoir. In the summer and autumn months almost the whole of the water in the high-level reservoir is in this way obtained by pumping. But in winter and early spring pumping is seldom resorted to, as then the high-service reservoir is ordinarily kept full by a small stream, the Tregonhay Stream, which enters at its south-west corner. This stream was scarcely running at the date of my visit. It has a course of nearly half a mile. Its water, no doubt, is principally surface water which reaches the stream either directly or by way of numerous tributary field ditches. The slopes hereabouts are pasture land, which was freely manured at the date of my visit. Drainage of a farmyard and midden at Tregonhay Farm passes to a ditch leading into this stream.

A conduit and sluice have been provided by which flood water in Tregonhay Stream can be diverted from the high-service reservoir if desired. It appeared likely, however, that flood water, if thus diverted, would merely run down the hill into Number 1 reservoir, and so after all contaminate the supply. Recently a small bed of sand has been provided at one corner of the high-service reservoir, through which it is intended that Tregonhay water should percolate. In addition to Tregonhay Stream, the high-service reservoir receives unfiltered the natural drainage of manured fields above its banks.

DISTRIBUTION OF WATER IN FALMOUTH.—The bulk of the water mains in Falmouth were laid down about 1848, when the Water Company commenced its undertaking. The high-level main was laid in 1877. Branch mains, especially on the low-level service, in a large number of cases terminate at "dead ends." At one time these dead ends were periodically washed out, but this desirable practice, I was informed, has for some years been discontinued. Most hydrants are "screw down" of an old pattern, which in the absence of systematic attention are liable to leak.

Mains have in some cases been laid undesirably near the surface of roadways, with the result, so I was told, that heavy traffic is apt to cause fractures, particularly at the ferrules by which supply pipes of houses are taken from the mains. Domestic water pipes usually consist of lengths of lead piping joined together by "taff-" or by other roughly constructed joints. Satisfactory "wiped" joints are not often met with. These pipes often run a needlessly tortuous course. Frequently they are laid alongside and sometimes (*e.g.*, in Clifton Place) underneath the house drains. Above ground they are not seldom placed against outer walls in positions where they are readily damaged. Connections of domestic supply pipes with the mains appear in the majority of cases to have been made by builders or other persons not employed by the Company, and even now, it would seem, such persons frequently are allowed to make connections or otherwise interfere with the water service without their work being adequately supervised. Frequently when a supply of water has been required for a house the builder, rather than connect to the main, has made a junction with the nearest pipe in neighbouring premises.

Except for supply to their water closets, very few Falmouth houses have cisterns. In most of the smaller dwellings the domestic supply is obtained from a tap in the scullery or in the yard outside. Often in the courts and poorer streets a single tap in a common yard serves a large number of dwellings; sometimes this arrangement is far from adequate—for example, Summer Court, where a small yard tap forms the sole supply of a series of three-story tenement houses, estimated to contain about 50 inhabitants. Taps in yards and sculleries are usually of the 'screw-down" pattern, but very often they are out of order and cannot be turned fully off, while frequently the inhabitants make no attempt to shut taps, letting water run to waste. The amount of water wasted in this way must be very great.

Intermissions in the supply.—In the winter months the volume of water passing into the main reservoir is sufficient not only to furnish a constant supply to the Falmouth low-level service and to Penryn, but also to afford a considerable surplus, which runs away into natural channels by a byewash. Similarly in winter the high-level reservoir is ordinarily kept full by the Tregonhay Stream, and no water is pumped into it. From early spring to late autumn, however, as has been said, Tregonhay Stream partly or wholly fails, and correspondingly the high-service reservoir is kept full by pumping. So soon as any pumping has to be undertaken, the high-level supply of Falmouth is turned off every night (save on Friday) from 10 p.m., or earlier, to 6 a.m. In 1899 pumping and nightly intermission on the high-level had begun in March, and was continuing at the date of my visit in September.

On the low-level service the main reservoir in ordinary years affords sufficient storage to make intermission unnecessary even when, owing to drought, next to no water is reaching it. But in exceptionally dry summers it has been necessary for a time to turn off the low-level supply at night. This year, for example, the low-level supply was thus intermitted for a few weeks after the beginning of October.

Local complaints at Falmouth as to *deficiency in quantity* of the supply appeared due to three circumstances. The first (*a*) was the deficiency which must necessarily be experienced in the case of any supply such as that to Falmouth high levels in summer, where water is turned off during certain hours out of the twenty-four, and cisterns are not in general use. The second (*b*) was lack of pressure. The roadway level in a considerable portion of the area on the high-level service is between 170 and 190 feet above Ordnance Datum, the top water level of the high-service reservoir, between two and three miles away, being 265 feet. The area served by the high-level supply does not, however, comprise only the higher parts of the town. At the south-eastern end of Falmouth high-service mains serve a considerable number of dwellings (including certain large houses and hotels) not much more than 50 feet above the harbour, while the trunk main of the high-service terminates at a point only some 26 feet above Ordnance Datum. At hours of the day when the demand for water in these lower lying parts of the town becomes considerable, water often cannot be got from taps in the higher parts of the high-service. The third circumstance (*c*), relating to high and low-level service alike, was the frequency of what may be termed individual failure of supply. Almost anywhere in the town it is no uncommon occurrence for a tap to yield a mere dribble of water, or, perhaps, to fail altogether, notwithstanding that the water mains at the time are under pressure. This may in some cases be due to local peculiarities of the distributing pipes, as where a house has a small supply pipe which on its way from the main has offshoots to taps in other houses; or where, as is often the case, the water main supplying a street is of small calibre in proportion to the number of houses which it serves, and its working diameter has been further reduced by deposits in the pipe. In such cases a householder may, practically speaking, find himself at his neighbour's mercy for his supply. Apart from this, however, the principal cause of failure of individual taps to run is blocking of domestic supply pipes by matters in suspension in the water, to which I refer below. The usual point of lodgment of such matters is at ferrules which connect these pipes with the mains. Each week in the summer of 1899—and the same thing happens, I was informed, nearly every summer—numerous instances of blocked house pipes occurred. By way of remedy the recognised practice is for the householder to get a workman of the company, or to engage a man himself, to open the roadway, detach the ferrule, and, if the obstruction is not there discovered, to blow out the house pipe by a force pump. The frequency of occurrences of this sort is no doubt largely responsible for an otherwise scarcely intelligible custom in the Falmouth water service. For many years the water, on both high and low-level services, has been completely turned off during the greater part of the daytime of each Friday in order to allow repairs, connections, and disconnections of water mains to be made at any point of the town.

Complaints as to quality.—At the date of my visit to the waterworks, samples which I took from each of the reservoirs were clear, although they had in each instance a slight brown tint, characteristic of peat. Of water drawn from taps in Falmouth accounts varied greatly. In many places tap water had the same naked-eye appearance as at the reservoirs, and was said always to be of this character. But elsewhere, particularly on the lower part of the low-level service, tap water had a marked yellowish-brown tint, contained matters in fine suspension, and occasionally caused considerable deposit of brownish sediment in vessels. This, I am told, is also a frequent characteristic of tap water in Penryn. At some taps discolouration and turbidity were said to be almost invariable characteristics of the water; in other cases these appearances were stated to be only occasional, occurring most often when the water was turned on after the supply (as on Fridays) had been intermitted. Complaints of "dirtiness" of the water are said to come in large measure from dwellings near to "dead ends" of mains.

On inspection of certain of the water mains in the town, when the water was turned off, I found in each instance the interior

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of the pipe was lined with dark greenish-brown slime, which appeared to consist of vegetable matter. This material, it may be plausibly inferred, has been derived to a considerable extent from the main reservoir, at the margins of which, as has been said, there is peat in considerable quantity. How far, if this is the case, the slime which has this year been present in the Falmouth mains is, as it were, a survival of peaty matters introduced into them from the main reservoir before sand filtration was begun at the end of 1898, or how far it consists of matters which have passed the filter bed, I have no means of judging.

Samples of water from the Falmouth waterworks have of late years been analysed on several occasions by different chemists. In the following table I give the results of certain more recent analyses, expressed, for convenience of comparison, in parts per 100,000 in each case. All the samples in question were collected in dry weather. I could not learn of any analyses of samples taken after considerable rainfall.

PARTS PER 100,000.

—		Total Solids in Solution.	Free Ammonia.	Albuminoid Ammonia.	Chlorine.	Oxygen Absorbed in Four Hours.	Nitric Nitrogen.
1. Two samples of tap water collected by Dr. Blamey, at different points in Penryn, on September 6th, 1899, analysed by Mr. Benedict Kitto.	A.	13·7	·042	·034	3·4	·214	Traces.
	B.	11·1	·036	·052	3·4	·4	Traces.
2. Sample of tap water at Penryn, analysed by Mr. J. Muter on August 16th, 1899, at request of Dr. Blamey.		11·0	·003	·013	3·6	·152	0
3. A series of samples collected by the Borough Surveyor on September 19th, 1898,* analysed by Mr. Harland :—							
A. Mabe Stream, 150 yards above point of entry to main reservoir.		13·0	·007	·008	3·1	·18	·66
B. Main reservoir		14·0	·043	·024	3·4	·28	·48
C. High-level reservoir ...		13·0	·036	·02	3·6	·2	·58
D. Tap on high-level service at Falmouth.		14·0	·014	·02	3·4	·17	·42
E. Tap on low-level service at Falmouth.		14·0	·011	·022	3·6	·23	·51

Diverse opinions with regard to the presence or absence of contamination with animal organic matter have been expressed by chemists to whom these and other samples have been submitted. Interpretations of chemical results as indicating merely the presence of organic matter of vegetable origin have found favour with the water company, while opinions that analyses point to superadded contamination with animal organic matters have been largely made use of by the company's critics. In effect, the data furnished by the analyses quoted above are insufficient to justify definite pronouncement in favour of one of these views rather than of the other. The proportion of ammonia (free and albuminoid) in Falmouth water may find explanation either in the vegetation of the gathering ground or of the main reservoir, or in the sources of animal pollution which have already been described as threatening the purity of the supply. Or, it may be, both sets of conditions are to be held responsible for some share of these constituents of the water. The presence of chlorine in the water in the amounts indicated is, no doubt, mainly to be referred to the proximity of the gathering area to the sea. It may be noted that in the samples A to E analysed by Mr. Harland the proportion of nitrates is high, and is suggestive of pollution by organic matters of animal origin.

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* Before the sand filter was provided.

I may briefly refer to certain other sanitary conditions of Falmouth. Several houses are used as *common lodging houses*, but none are registered as such by the Town Council, although a series of byelaws for common lodging houses, adopted in 1867, is nominally in force in the district. No regulations have been made as regards *dairies, cowsheds, and milkshops*, of which no register is kept. Three cowsheds which I visited in the borough were badly paved and drained.

Most milk is brought into the town from outside the borough. It is generally distributed by milk vendors as soon as it arrives, and only small quantities are stored in shops. The places of storage which I saw were outside the dwelling in each instance, and appeared clean. There is only one *slaughter house*—a private one—in the borough. It was clean at the date of my visit, but it lacks a convenient supply of water. There are 21 *bakehouses* in the town, which are from time to time inspected by the Medical Officer of Health.

There is a considerable public park near Berkeley Vale, presented to the town some years ago by the Earl of Kimberley.

PART II.—ENTERIC FEVER.

Enteric fever in Falmouth antecedent to 1899.—The last occasion on which there was serious prevalence of enteric fever in Falmouth appears to have been in 1890, when in Falmouth Borough and Parish (with a joint population of 11,410) 10 deaths were reported, being at the rate of 8·8 per 10,000 of population.

Since 1892, the date of enlargement of the borough and of the adoption of the Infectious Disease (Notification) Act, the occurrence of notified cases of, and of deaths from, enteric fever has been as in the tables A and B below. For comparison I have added corresponding figures with regard to the four towns in the south-western district of England, for which the notification returns are summarised in the annual reports of the Medical Officer of the Local Government Board:—

TABLE A.—ENTERIC FEVER ATTACKS, 1893–98.

Towns.	1891 population.	Enteric Fever Attacks notified.						Annual "Notification" Enteric Fever.* Attack Rate per 10,000 of 1891 population.						Six years, 1893-98.	Towns.
		1893.	1894.	1895.	1896.	1897.	1898.	1893.	1894.	1895.	1896.	1897.	1898.		
Falmouth	12,217	20	33	18	13	13	20	16·3	27	14·7	10·6	10·6	17·3	15·9	Falmouth.
Exeter	37,404	62	55	37	63	96	95	16·6	14·7	9·9	16·8	25·7	24·9	18·2	Exeter.
Plymouth	84,248	56	38	28	28	49	40	6·6	4·5	3·3	3·3	5·8	4·7	4·7	Plymouth.
Devonport	54,803	49	31	40	35	29	39	8·9	5·7	7·5	6·4	5·3	7·1	6·8	Devonport.
Bath	51,844	13	24	11	22	12	17	2·5	4·6	2·1	4·2	2·4	3·3	3·2	Bath.

* NOTE.—Data for comparison with towns in England and Wales other than those given in the above table may be found in Table D of Dr. Theodore Thomson's Report to the Local Government Board (1898) on Enteric Fever in the Swinton and Pendlebury Urban District. When the 50 towns dealt with in that table were taken together the enteric fever attack rate during five years, 1893–97, was found to be 10·3 per 10,000.

TABLE B.—ENTERIC FEVER DEATHS, 1893–98.

Towns.	Total Enteric Fever Deaths.						Annual Enteric Fever Death Rate per 10,000 of 1891 population, in six years 1893–98.*
	1893.	1894.	1895.	1896.	1897.	1898.	
Falmouth	3	2	2	1	1	1	1·4
Exeter	7	8	8	13	15	9	2·7
Plymouth	7	11	6	5	8	4	0·8
Devonport	5	2	11	10	8	12	1·5
Bath	3	0	5	6	3	3	0·6

* NOTE.—The England and Wales annual death rate from "fever" (including enteric fever, typhus fever, and continued fever) per 10,000 living for 10 years, 1888-97, was 1·7.

It will be observed that in each of the above six years cases of enteric fever occurred in Falmouth, and that, judging by "notification returns," the attack rate has been in excess (save in the case of Exeter in certain years) of the corresponding rate in any of the four south-western towns with which comparison is made. On the other hand, the number of deaths from enteric fever recorded during these years in Falmouth has been singularly few by comparison with the number of notified cases.

Of the 20 notified fever attacks in 1898, five were reported during the first six months of the year, three in July, two in August, one in September, three in November, and six in December.*

Enteric Fever in Falmouth during 1899.—Up to September 30th, cases were notified month by month as follows:—

Enteric Fever.	January.	February.	March.	April.	May.	June.	July.	August.	September.	Total for Nine Months.
Cases notified	3	4	7	2	5	10	7	47	27	112
Of which were fatal ...	—	1	—	1	—	2	2	4	2	12
Houses newly invaded during each month.	3	4	5	1	4	7	5	32	23	84

Thus, for the first nine months of 1899, the enteric fever "notification" attack rate was, per 10,000 of the 1891 population, 90; and the enteric fever death rate was 9·8.† The figures in the above table, it should be noted, take no account of persons who in places outside the borough were attacked by fever presumably contracted in Falmouth. Several such cases, of which one at least was fatal, were stated to have occurred among visitors to the town during August and September. It should also be borne in mind that the notified cases may not comprise the whole of the persons in the borough who were attacked by the fever. In certain instances, for example, where suspicious illness had not been notified as enteric fever, the patient's medical adviser informed me that, looking back to all the circumstances, he now thought that the illness had been enteric fever.

Two or three of the 112 notified cases had been treated in the small "general" hospital of the town; three others in the "Sailors' Hospital." The remaining cases had in each instance remained at home during illness.

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* Of the nine dwellings invaded by enteric fever during November and December, 1898, five were outside and four inside the "central area" referred to below in relation with the epidemic of 1899.

† Whilst this report is in the press, I learn from Dr. Bullmore that 28 additional cases of enteric fever were notified in October, and other 12 in November, a total for 11 months of 152. During October and November four additional deaths from enteric fever were registered in Falmouth.

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No information as to the age of sufferers by the fever had been obtained at the date of my inspection. From information since given me, however, it appears that the age distribution of the 112 cases was as follows:—

January 1st to September 30th, 1899.	0—	5—	10—	15—	25—	35 and upwards.	Not ascertained.	Total.
Notified cases of Enteric Fever.	2	24	33	25	11	14	3	112
Of which were fatal.	—	—	3	4	3	2	—	12

Inquiry had not been made as to the approximate date of onset of illness in cases coming to the knowledge of the officers of the sanitary department. From the data above summarised, however, it seemed evident that, up to the date of my visit, the year 1899 could be divided into two consecutive periods characterised by the different behaviour of enteric fever in each. The first seven months, up to the end of July, constituted a period of prevalence of fever, notable indeed, but not of such proportions as to be termed epidemic. To this had succeeded a period of two months, August and September, of manifestly epidemic enteric fever. During the latter period cases came to the knowledge of the sanitary authority on dates shown in Table C.

In the case of certain dwellings invaded during this period, medical practitioners in the town were good enough to give me information as to dates of onset of illness of the inmates. In several instances where two or more persons in a dwelling had been attacked, they appeared to have sickened together, or within a few days one of another.

Localities invaded.—Nearly all the streets in which cases of fever occurred during the first seven months of the year were comprised in a wide area in the centre of the borough. This "central area," as it may be termed, extends from the neighbourhood of Albany Road on the south-west to the harbour between Market Strand and the Parish Church on the north-east. It includes, perhaps, as much as half the populous part of the borough. Of this central area the southern portions stand comparatively high; it also comprises slopes falling sharply to strips of low lying ground in the valley of "The Moor" on the north-west and alongside the harbour on the north-east.

No particular streets could be picked out in which, during the seven months in question, there had been special prevalence of fever: invaded dwellings were, however, mainly scattered throughout the higher parts of the central area. One or two larger private houses were invaded, but most of the dwellings were of the better artisan type. In the lower parts of the central

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TABLE C.—DATES UPON WHICH CASES OF ENTERIC FEVER IN FALMOUTH WERE NOTIFIED TO THE MEDICAL OFFICER OF HEALTH DURING THE EPIDEMIC MONTHS, AUGUST AND SEPTEMBER, 1899.

—	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total.
August.																																
Cases notified ...	1	1	—	—	—	—	—	9	—	—	—	2	—	—	7	3	—	—	—	—	1	1	14	—	—	—	—	3	3	1	1	47
Houses newly invaded.	1	—	—	—	—	—	—	6	—	—	—	2	—	—	4	2	—	—	—	—	1	1	11	—	—	—	—	2	1	1	—	32
September.																																
Cases notified ...	—	5	—	1	1	—	—	—	1	—	1	—	2	—	—	2	—	3	1	2	3	2	—	—	—	—	1	2	—	—		27
Houses newly invaded.	—	4	—	—	1	—	—	—	1	—	—	—	2	—	—	2	—	3	1	2	2	2	—	—	—	—	1	2	—	—		23

area, which comprises some of the principal shops and also some of the poorest quarters in Falmouth, relatively few dwellings were invaded.

During the epidemic months, August and September, the incidence of the disease was again greatest in the same large central area, in which 47 out of 55 invaded houses were situate. The dwellings now newly invaded were irregularly scattered over the whole of the area; only in one or two instances (as at Higher Brook Street) was there any conspicuous grouping of them. Dwellings in low-lying parts of the central area, during this epidemic period, sustained, if anything, relatively greater incidence of fever than the higher levels.

AS TO THE CAUSE OF THE FEVER.

No particulars of *occupations* of persons attacked had been obtained, but I could not hear of instances where a considerable number of persons employed in common at any one shop or workshop had been attacked.

Inquiry as to *milk* had been made in the majority of cases notified. The information obtained, so far as it went, did not indicate exceptional incidence of fever upon the customers of any one dairy, during either the period of epidemic prevalence of the disease or the period of less prevalence immediately antecedent. Almost every one of the dairies from which the invaded houses were supplied, I was informed, receives its milk from a separate farm. No inquiry had been made as to other articles of food. In view of the unsatisfactory position of certain oyster layings in Falmouth Harbour and Penryn River in regard of sewer outfalls,* I made some inquiry as to ingestion of oysters by persons attacked, but without affirmative result. Cockles and mussels are seldom gathered in Falmouth Harbour.

As to *sewers* in relation with the fever. The wide central area in which the majority of the invaded houses are comprised is served by three main sewers which, along with two or three others, unite close by Market Strand to form a short outfall sewer leading to the sewage tank and so to the harbour. Broadly speaking, there did not appear to have been a disproportionate incidence of fever on dwellings in any one of the three sub-areas served by these main sewers, in either of the periods of fever prevalence under consideration.

Locally stress was laid upon sewer air in relation to the fever prevalence. The house drains of invaded dwellings, tested by smoke test, in almost every case had been found defective: many of them were examined and found to leak where they passed beneath or alongside dwellings. Falmouth sewers not being provided with ventilating openings, sewer air might readily be drawn into houses through defective drains so situate. It should be remembered, however, that defects of this sort are far from being peculiar to the invaded dwellings or to the central half of the town: seemingly they have been met with in whatever part of the borough house drains have been looked to.

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* *See* Dr. Bulstrode's observations on pages 56 to 58 of the Supplement to the Twenty-fourth Annual Report of the Medical Officer of the Local Government Board "On Oyster Culture in relation to Disease," 1896. Certain cases of enteric fever which occurred in Falmouth at the end of 1898 were locally attributed to swallowing oysters obtained from layings in Penryn River, in front of Flushing. Whether or no this was a correct explanation, it may here be noted that oysters in Penryn River are still exposed to the opportunities of pollution by sewage from Flushing and elsewhere to which Dr. Bulstrode drew attention in his Report. Four cases of enteric fever occurred in Flushing during the last three months of 1898.

As has been said, the contents of the three systems of sewers which serve the central area in each instance pass through the short outfall sewer and sewage tank before being discharged into the harbour. The main sewers of other important systems which lie outside the central area in question, in particular the Webber Street and Berkeley Vale main sewers, also enter this short outfall sewer. If, therefore, sewer air which had received infective ability in outfall sewer or in sewage tank had passed into the central area and therein had operated as an important infecting agent, it was to be expected that air similarly infectious would have reached sundry localities outside the central area which are served by the other main sewers to which I have alluded. But in point of fact scarcely any houses in the sub-areas served by these other main sewers were invaded by the fever at any period of its recent prevalence.*

Alternatively, explanation may be offered that in each system of sewers serving the central area, sewer air acquired infective quality independently of, but in parallel fashion to, the two other systems of that area. Such an occurrence is somewhat improbable. Nevertheless, it must be admitted that if sewer air escaping into dwellings is as matter of fact capable now and then of carrying with it the infective material of enteric fever, then in the circumstances of Falmouth the possibility that certain of the persons attacked came by their infection by such means may hardly be denied.

As to the relation of *local pollution of soil* in Falmouth to the prevalence of enteric fever in 1899, the facts at my disposal do not suffice for definite inference. Question arose, given multiple cases of enteric fever at several points in the central portion of the town during earlier period of fever prevalence, had there ensued consequent creation of corresponding multiple points at which the soil had become contaminated with infectious matter from enteric fever patients? And, if conditions of the sort had been thus created, was the epidemic of August and September determined by seasonal or other influences under which this specifically polluted soil acquired augmented potency for harm?

As to the first part of such a thesis, there can be little doubt that by means of infectious matters cast on to the surface of unpaved or badly paved yards, and by infectious excreta reaching defective house drains close below the surface, specific contamination of surface soil may have taken place in certain cases during the months which preceded the epidemic. And, maybe, as there has been reason to suspect in Chichester and other places, soil thus contaminated remained infectious, or potentially infectious, months after infecting matters had ceased to gain access to it.

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* Some residents who, perhaps not unnaturally, look upon the Market Strand sewage tank as the embodiment of things objectionable, urged that large volumes of sewer gas are generated in this tank and forced up the outfall sewer and some or all of its tributaries. I could obtain no evidence, however, that such generation of gas in fact occurs.

It should, however, be observed that certain facts of the epidemic period scarcely squared with a hypothesis of an August and September outbreak directly attributable to augmented infectivity of locally and specifically contaminated soil. It will be remembered that the dwellings known to have been invaded during the earlier period of fever prevalence were for the most part on the high ground of the central area of the town, whereas in the later or epidemic months the incidence within this central area was relatively greater on dwellings on the low ground near to the harbour and along the valley of "The Moor." Moreover, on the hypothesis in question, some grouping of dwellings invaded during the outbreak in August and September around houses in which fever was known to have occurred during the earlier period of its prevalence might be looked for; whereas there was in fact little evidence of grouping of invaded dwellings in this way. For detailed study of the question of soil pollution, however, knowledge of the incidence of enteric fever upon locality in Falmouth for a series of years before 1899 is necessary. But, owing to the absence of records in the sanitary department, I was not in a position to pursue investigation in this direction.

Next as to *water supply.*—According to inquiries made by Mr. Kelway, Inspector of Nuisances, all but one of the dwellings invaded during 1899 were supplied with water by the Falmouth Waterworks Company. The exception was Arwenack Farm, which has its own well. Here there was a single case of fever, which proved fatal—that of a girl who went to school in the town, and was said frequently to have drunk town water. In the central area of the town a small proportion of dwellings are served by local springs such as I have already referred to. One of these dwellings was invaded by the fever, but I learnt that the inhabitants used tap water for drinking purposes.

In view of the sundry dangerous conditions obtaining on the gathering ground and of the untrustworthy character of the filtration practised at the waterworks, question arose of specific contamination of the water reaching the company's reservoirs and passing thence to the mains. Were there any facts suggesting that such contamination had taken place during 1899, and had the behaviour of enteric fever in Falmouth in this year, and particularly during the epidemic months, been consistent with an infective ability of the general supply of the company?

On the first head, I learnt from Dr. Blamey, Medical Officer of Health of East Kerrier Rural District, that between January 1st and the end of September, 1899, three cases of enteric fever had been notified to him as occurring in two dwellings on the gathering area. The first, on July 4th, was a farm labourer living at Tinpit Cottages. This man had been at home ill with fever during some four or five weeks. Excreta and refuse at his dwelling are disposed of in a privy midden, and slop water runs on to a field behind the house, over a quarter of a mile from the main reservoir, down to which the ground slopes gently from his cottage. It is not impossible that washings from soil polluted by slop water or midden refuse hereabouts might be carried directly to the reservoir after a considerable period of wet; but, having regard to the physical conditions, such an occurrence would seem unlikely, even in time of heavy rainfall. As a matter of fact, Dr. Blamey informs me, excreta in this case of fever were, by his instructions, disposed of with special precautions. Moreover, there was during July, August, and the early part of September, nothing approaching heavy rainfall on the gathering area, as will be seen from the rain record kindly supplied to me by Mr. Kitto, of the Falmouth Observatory, and appended to this report.

At Halvosso, on the gathering area, one other dwelling had been invaded by enteric fever, and here two cases of this disease, apparently contracted in Falmouth, occurred. In both the illness appears to have commenced on the 23rd of August, too late a date to be thought of in connection with hypothesis of specific pollution of the water service as a cause of the Falmouth epidemic. And at Halvosso, as has been stated, risk of pollution of water-courses contributing to the supply is very remote. In course of my inspection of the gathering area, I made local inquiries for other cases of illness in 1899, bearing suspicious resemblance to enteric fever, but without affirmative result.

To deal with the second head. Throughout the year water from the main reservoir, filtered as described, formed the only source of public supply to Penryn and to the low levels of Falmouth. After March, the high-level supply of Falmouth consisted almost entirely of the same filtered water from the main reservoir as was being furnished to Penryn and to Falmouth low levels.

Now, as regards enteric fever in Penryn, Dr. Blamey informed me that during January, 1899, two cases of fever in that borough had been notified to him, but that from the end of that month to September 21st no additional cases of enteric fever in Penryn came to his knowledge. On the latter date two cases of enteric fever were notified and one other on September 22nd; illness in each instance having begun in the second week of September. Whatever may have been the origin of infection in these five cases, it was apparent that during 1899 there was no such parallel between the incidence of enteric fever on Falmouth and on Penryn as was to be expected if a contaminated water service common to both places had been responsible for the prevalence of the fever in Falmouth.

Similar contrast was afforded between the heavy incidence of fever on the central area of Falmouth and the comparatively slight incidence upon the remaining populous area of the borough. In each area alike nearly all the houses received the company's water.

Question of specific contamination of water service, but *limited in operation mainly to the central area of Falmouth*, remained to be considered.

As has been said, water mains in Falmouth are, from one or another cause, interfered with unusually often: mains and domestic supply pipes are frequently placed in positions liable to injury; joints of domestic supply pipes are commonly unsatisfactory; and there are many "dead ends" which receive no attention. The high service of Falmouth had this year been intermitted nightly since March, and once a week throughout the year the supply to both high and low service had been cut off for several hours of the day. All these circumstances suggested that there might very well be points of leakage on the water service at which insuction must needs from time to time take place, and the possibility of insuction having occurred at points where soil was locally contaminated by enteric fever infectious matter could not be disregarded in seeking for explanation of the spread of the fever. Particularly did question of insuction arise in relation with the epidemic period of August and September. Could insuction of infectious matters into water pipes have occurred at such times and in such a locality or localities as to be capable of affording explanation of the exceptional incidence of enteric fever during this period upon the central area of the town?

In dealing with this question I inquired, in the first instance as to the situation of the 83 dwellings in the borough supplied by the company's water which had been invaded by enteric fever between January 1st and September 30th in regard of service by high level or by low-level systems of mains, with results as follows:—

Houses Newly Invaded (from Notification).	Jan.	Feb.	March.	April.	May.	June.	July.	Total in Seven Months.	Aug.	Sept.	Total in Two Months.
On high service ...	3	2	2	1	4	6.	3	21	15	9	24
On low service ...	—	2	3	—	—	—	2	7	17	14	31

It will be seen that, as regards the whole borough and during the epidemic period, there was a large number of invaded dwellings on each service. The same was true during this period for the central area of the town in which nearly all the houses invaded during the epidemic were situate. Taken roughly, about half the dwellings of this central area are served by high-level mains, and about half are on the low-level supply.

Next I inquired as to distribution of the water mains within the central area, and as to connections between high and low-level services therein. Broadly speaking, so much of what I have termed the central area is on the high-level is bounded on the south-west by the high-level trunk main along Western Terrace, on the south-east by a principal (8-inch) branch of this trunk main laid along Marlborough Road, and on the other two sides by the limits of the low-level service. The trunk main, in the Western

Terrace, lies just behind the crest of the high ground which skirts the populous parts of the borough; Marlborough Road main, at a right angle to the trunk main, lies along the crest of a spur of high ground projecting towards the harbour. The high-level central area occupies the north-western slope of this spur. It is supplied from inter-communicating branches of the Marlborough Road main, and of the trunk main, and everywhere this area falls by gentle slopes away from these two mains down to the limits of the low-level service.* Besides conveying water to the high-level central area, the trunk and Marlborough Road mains serve other localities in Falmouth in which during 1899 there had hardly been any prevalence of enteric fever. These localities lie to the south-east of Marlborough Road:—in other words they are separated from the central area by the crest of the spur.

When, therefore, the high-level service is shut off, as it is every night, water left in the mains of the high-level central area tends to be drawn, along with any matters sucked into the pipes, to open taps within, and principally at the lower parts of the area, but would not find its way uphill back from these lower levels within the area to the trunk or Marlborough Road mains and so be distributed to parts of Falmouth that are outside the area. Similarly when the water is turned on, as it is every morning, any matters sucked into the main of the high-level central area during intermission of the supply might readily be carried by the incoming stream for considerable distances within the area; it is altogether unlikely that they would, as it were, be driven up into the trunk and Marlborough Road mains and so out of the central area altogether.

As regards mains in that part of the central area which is on low-level service. The low-level trunk main is laid parallel to the harbour throughout the whole length of the town, from north-west to south-east. It has two long branch mains extending up either side of the valley of "The Moor"; elsewhere, however, its numerous branches are short and of comparatively small calibre. Many terminate in "dead ends." The central low-level area is in part supplied by numerous short branch mains of this kind, and, in part, from the longer Killigrew Street branch main, which serves the south-eastern side of "The Moor" valley.

I have said that it is the custom in Falmouth to turn off water during certain hours each Friday, both on the high and on the low-level service, to permit repairs, connections, and the like. On inquiry of the Company's water bailiff, Mr. Stephens, who personally superintends these Friday operations, I learnt that after both supplies have been turned off, in order to accelerate the emptying of the high-level mains, it is usual at certain points where mains on the two systems meet to open cocks which at other times shut off the high-level water from the low-level mains. The consumption of water in the lower levels of the town then

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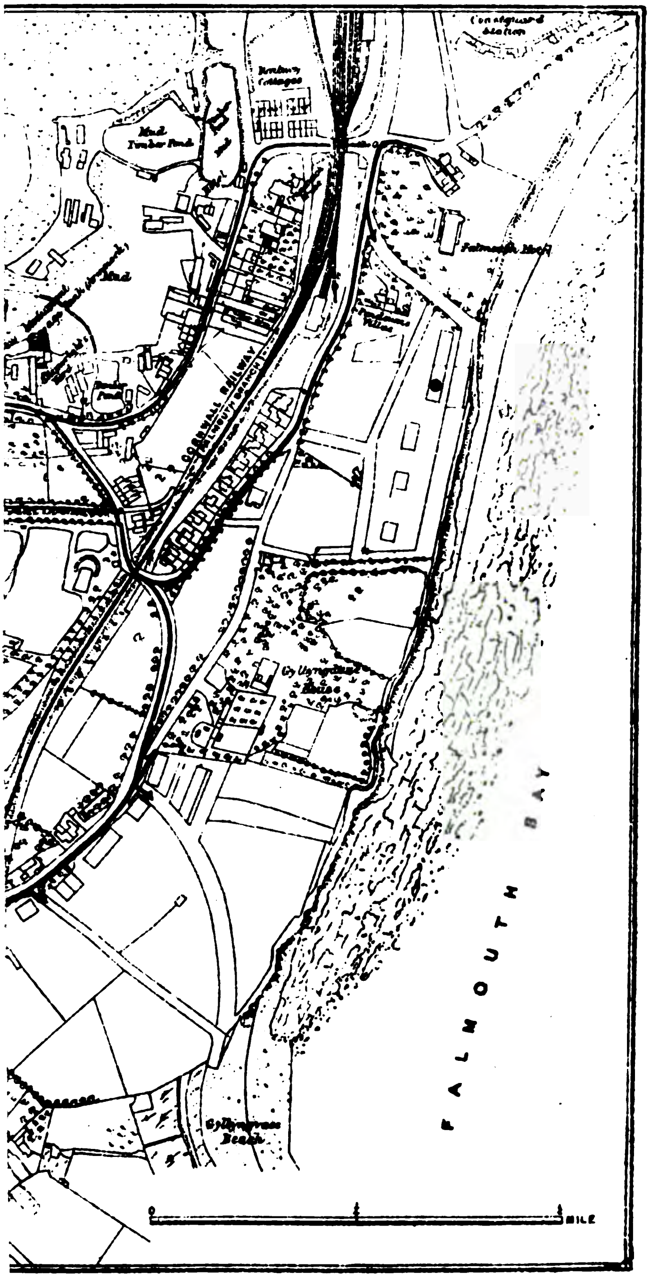
* In the appended plans these principal mains are shown as they appear in a map of the Falmouth mains kindly lent to me by Mr. Cox. Many of the branch mains in the high-level central area, however, do not appear on any plans at the office of the Waterworks Company. On each plan I have shown approximately a series of 30-feet contours.



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APP. A, No.

On Enteric
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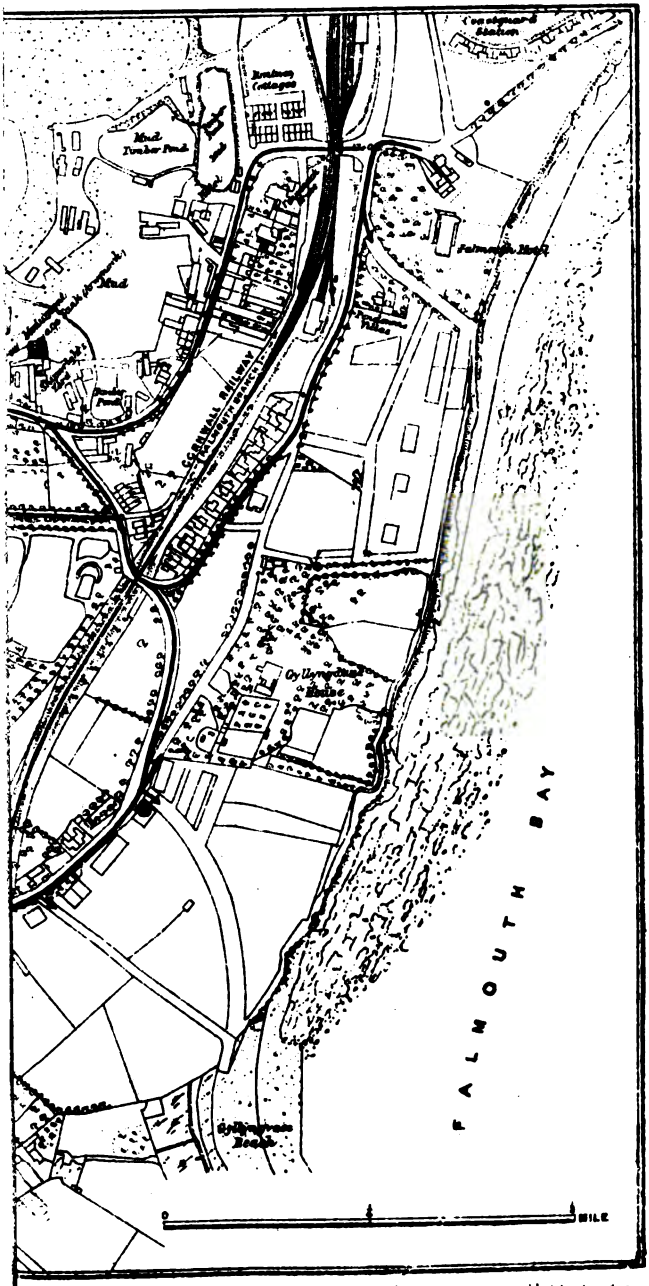
Dr. Buchana



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App. A, N

On Enteri
Fever in
Falmouth
Dr. Bucha

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ASTOR, LENOX AND
TILDEN FOUNDATIONS

rapidly empties the mains at a higher level, and in addition there are certain points at which, if necessary, water in the low-level mains can be run out into the harbour. Clearly, therefore, when such connection between the systems is established on Friday, not only does high-level water reach the low-level mains in considerable quantity, but at that very time, on the high-level, opportunities of insuction to the pipes of that service occur in excess of those afforded by the usual nightly intermission.

In the central area of the town there are three or four connections of this sort, *e.g.*, at the foot of Upper Brook Street; opposite the school at the end of Clare Terrace; and in Killigrew Street. Mr. Stephens informed me that the cock at the latter junction, an important one, was, to the best of his recollection, opened every Friday throughout the summer.

Taking into consideration these circumstances of the water service, and recalling that during the months preceding the epidemic opportunities of local soil pollution were especially numerous in the high-level central area, it is, I think, permissible to surmise that the occurrence of insuction of infectious matters into the water mains at some point or points in the high-level service shortly before and during the epidemic period would go far to explain the local incidence of the fever during that period. For as regards the high-level central area, infectious matters thus sucked in might, as I have shown, very well find their way to sundry domestic pipes and taps at different points within the area, but would be much less liable to pass to other localities of the town supplied from high service. And as regards the low-level, if infectious matters sucked into the high-level mains of the central area were carried down into the low service mains by way of junctions such as that at Killigrew Street, then they would probably become distributed within a central low-level area lying between these junctions and the harbour—an area, in fact, such as that which comprised most of the low-level dwellings invaded during the epidemic period. It should here be noted that the taps serving many of these dwellings were at some of the lowest points of the low-level service. Water contaminated with infective material, if admitted into upper mains of the low-level system at a time when the low-level supply (as on Friday) had been cut off, would more readily pass to taps connected with the lowest mains than to those elsewhere on the low-level system.

Here is an instance where infectious matters may well have been drawn into mains of the high-level central area by insuction. A small house, 93, Killigrew Street, receives high-level supply by a ½-inch pipe from a 4-inch main in the roadway, a descending branch of the high-level trunk main. In this house two cases of enteric fever were notified during 1899. The first, a boy, H. T., aged 10, sickened with fever in the third week of March, and was treated at home throughout his illness. The second, a girl of 18, fell ill on or about July 1st, and was likewise treated at home. She died on July 26th. In each instance, throughout the illness, excreta from the patient were disposed of in the water-closet of the dwelling, and slop water in the yard gully. The water-closet of the dwelling stood in a small back yard. It had no flushing apparatus. The closet drain consisted of 4-inch earthenware pipes, and was carried close below the surface of the yard to pass beneath the dwelling to the Killigrew Street sewer. The yard gully stood at the foot of the boundary wall of the yard, three feet from the water-closet, and was connected to a 6-inch pipe drain which joined the closet drain. Both these drains leaked freely at their joints: the occupier informed me, indeed, that at times when the closet was flushed by hand water oozed out between the irregularly laid flagstones of the yard. On removing several of the flags the soil of the yard was found to be everywhere black and evidently impregnated with foul organic matter. Along the boundary wall of the yard and beneath the surface passed the ½-inch lead water-pipe. Where this pipe reached the yard gully there branched off at right angles another ½-inch lead pipe to a tap over the gully. This right-angled junction had been roughly made, and in one part of it was a leak, whence water issued and soaked the soil around. The occupier informed me that to his knowledge leakage had here taken place for many months. Now there could be no doubt that as soon as there was negative pressure on the Killigrew Street main below the level of this leak—a condition which was bound to occur on Fridays when the cock connecting high and low-level mains further down Killigrew Street was opened, and which might occur, although to a less extent, when the high-level water alone had been intermitted—foul and possibly infective matters surrounding this leak would be sucked back into the service pipe and so into the watermain.* It is worth noting that the ½-inch pipe to the yard tap was continued beyond the back yard to a second tap which supplies a house the back of which looks on to 93, Killigrew Street. In this house—3, Lister Street—three out of six inmates had, during August, suffered from illness of from two to four weeks' duration, characterised in each instance by fever and diarrhœa. The medical practitioner who had attended this family had not notified any of these cases as enteric fever, but he informed me that, looking to all the circumstances, he had little doubt that all three persons had, as a matter of fact, been attacked by that disease.

MEASURES ADOPTED IN REPRESSION OF THE EPIDEMIC.

Under this head there is not much to chronicle. The sustained prevalence of enteric fever in the borough during the earlier months of the year appears to have passed almost unnoticed by the Town Council and their sanitary department. And in August,

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* I was able to put this to rough test as follows:—By making a miniature embankment of clay I kept up a pool of water round this junction, and observed this pool at an hour when the high-level supply had just been shut off. It was not then possible to turn the high-level water into the low-level main, but the emptying of the Killigrew Street main was accelerated by opening a hydrant which comes off this high-level main at a point below 93, Killigrew Street. After water had been running a short while from this hydrant the pool of water round the leaky junction, which up to that moment had been overflowing, suddenly disappeared—having been rapidly and completely sucked back into the pipe. It is fair to add that when this experiment was made the opening in the pipe had accidentally been made larger than it was when the pipe was first uncovered, but the original opening would obviously have allowed considerable in-suction.

On Enteric Fever in Falmouth; by Dr. Buchanan

when the disease had become unmistakably epidemic, there seems to have been a general desire in Falmouth to belittle the matter, in view of the visitors' season, rather than to take adequate steps to combat the progress of the outbreak. Some useful work can, however, be recorded. Visits to many of the invaded houses were made by the Medical Officer of Health, and frequently instruction was given, either by him or by the medical adviser of the patient, as to disinfection of excreta and of articles likely to retain infection. Disinfectants (principally "Jeyes' fluid") were supplied gratuitously by the Town Council. At the instance of the Medical Officer of Health, sewers at four of the highest parts of the town were provided with large ventilating shafts. The Inspector of Nuisances, Mr. Kelway, visited nearly all the invaded dwellings, and in a large number of cases detected defects of drainage and other matters to which, by the authority of the Town Council, he demanded that remedy should be applied. As a result, many house drains were relaid and other sanitary defects were dealt with. Unfortunately, however, much of this work, being done under pressure of panic, was carried out in a slipshod fashion—a fact of which I saw abundant evidence in course of my inspection.

No attempt was made to isolate any sufferers by the fever in hospital. The Town Council do not possess an isolation hospital, nor have they made any arrangements by which isolation in hospital of infectious cases can be secured. They have no disinfecting apparatus.

In September, at my suggestion, persons in the town were cautioned by public notices to boil all drinking water; flushing of sewers, which (owing to precautions which the Water Company was taking against possible failure of its supply through drought) had recently been almost discontinued, was renewed; and preliminary steps were taken to obtain the services of a trained inspector to assist Mr. Kelway, who was unable, single-handed, to cope with the large number of matters which required his attention.

Before concluding this report, I may briefly refer to conditions of sanitary administration in Falmouth, and to the most urgent needs of the place in a sanitary sense.

The Town Council consists of 16 members, and has committees for sanitary matters, for highways, and for consideration of questions of water supply. The Medical Officer of Health, Dr. J. King Bullmore, held the office for many years under the sanitary authorities of the "Old Borough" and of "Falmouth Parish." He is also Medical Officer of Health to the Port of Falmouth, and is engaged in private practice. His salary is £60, half of which is repaid from County Funds. Half the salary of the Inspector of Nuisances, Mr. Kelway, which is £100, is similarly repaid.

The Town Council have byelaws, sanctioned by the Home Office in 1867, as to New Streets and Buildings, Nuisances, and

Common Lodging Houses. The Infectious Disease (Notification) Act, 1889, was adopted in 1892; the whole of the Public Health Acts Amendment Act (1890) and of the Infectious Disease (Prevention) Act (1890) has been adopted.

The Town Clerk informed me that the present rateable value of the Borough is £40,106; the value assessable for the general district rate is £37,802. The borough has to provide a "rector's rate" of 1*s*. 4*d*. in the £; the present poor rate (including school board rate) is, in the "Old Borough" 4*s*., and in "Falmouth Parish" 3*s*. 6*d*.; the general district rate is 3*s*. in the £. Since 1870 a sum of £22,481 has been borrowed for public works; the proportion of this sum still owing at the beginning of 1899 was £13,513.

In the foregoing pages enough has been said to indicate that in many important matters of public health, administration by the authorities of the areas which are now comprised in the present borough was in the past conspicuously and regrettably lax. And it is to be feared that the Town Council of the present borough, which began work in 1892, has not greatly improved matters.

Looking to all the circumstances, it would seem that if Falmouth is to make satisfactory progress in sanitary matters—and on this the future of the town, whether as a health resort, as a watering place, or as an increasing place of business must largely depend—it is essential that the place should have a Town Council prepared to take thorough action, and to incur necessary expense, under capable guidance. To this end it would seem desirable that expert opinion which the Town Council are seeking with regard to the disposal of the town sewage should also be obtained with reference to the state of the sewers and general sewerage arrangements of the borough; that sustained effort should be made to secure the reconstruction of defective house drains and the better paving of yards; that the present antiquated set of bye-laws should be replaced by a new code, such as those of the Board's Model Series, and that the new bye-laws, when adopted, should be enforced; that dairies, cowsheds, and milkshops should be controlled by regulations of the Town Council; and that the Town Council should take measures for repressing infectious disease by providing, either by themselves or in conjunction with one or more neighbouring authorities, a sufficient isolation hospital and a good disinfecting apparatus. If substantial advance is to be made in certain of these directions capable assistance to the Inspector of Nuisances for some little time to come, if not permanently, can hardly be dispensed with.

In 1898 the Town Council resolved to promote in Parliament a Bill for the purchase of the undertaking of the Falmouth Waterworks Company. On a poll of ratepayers, however, sanction to this proceeding was refused; the ratepayers having, it was generally stated, too great a mistrust of the capacity of their own representatives for carrying out so large an undertaking. However this may be, the question is, I am informed, again about to be brought forward, and it may be useful here to point out certain essentials seemingly calling for prompt attention by the water authority, whether in the near future it is the Company or the Town Council. These are :—Frequent and systematic inspection of the gathering ground, with a view to preventing such opportunities of pollution as I have referred to on pp. 189 to 191; construction of sand filters, which will secure an efficiency of filtration conforming to modern standards; providing for the maintenance of greater pressure on the high-level service; discontinuing intermission of the supply; and, above all, a thorough "overhaul" and cleansing of the whole system of distributing water mains in the town. Search for leaky points in the course of the mains and at their terminations, and also in domestic supply pipes, seems particularly needful. Action of this kind should be taken, not only in Falmouth, but also in Penryn.

EXPLANATION OF PLANS.

In Plan I. the red dots indicate approximately the position of dwellings invaded by fever during the *seven months, January* 1*st* —*July* 31*st*, 1899.

In Plan II. the red dots indicate approximately the position of dwellings invaded by fever during the *epidemic months, August* 1*st*—*September* 30*th*, 1899.

The *blue* continuous lines represent principal high-level water mains. The *yellow* continuous lines represent principal low-level water mains. In each instance arrows indicate the direction of principal branch mains.

N.B.—Lansdowne Road main, shown blue on the plans, is at times supplied from the low-level as well as from the high-level surface.

The dotted blue lines are contours; drawn approximately from levels given on the 25-inch Ordnance map.

Streets and houses built since the publication of the Ordnance map on which these plans are based have been indicated in accordance with a plan kindly prepared for me by Mr. Tressidder, Borough Surveyor of Falmouth.

ADDENDUM.

Register of Rainfall in 1899 kept at Falmouth Observatory by the Staff.

Date.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Date.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	
1	1·130	—	—	—	—	—	·105	—	·025	1·045	·070		1
2	·600	—	—	·010	—	—	·040	—	·075	·245	·170		2
3	·040	—	—	—	—	—	·010	—	—	·110	·700		3
4	·100	·295	·025	·030	—	—	—	—	—	·190	·345		4
5	—	·985	—	·035	—	—	—	·150	·070	—	·010		5
6	·155	1·460	—	·135	—	—	—	·005	·025	—	—		6
7	·275	·320	—	·040	—	—	—	·005	—	—	·170		7
8	·015	·370	·215	·405	—	—	—	—	—	—	·335		8
9	·335	·365	·025	·015	—	—	—	·020	—	—	·705		9
10	·370	—	·020	·085	·030	—	·080	—	·005	—	·215		10
11	·315	·225	—	·015	—	—	·355	—	—	·080	·005		11
12	·440	·575	—	·405	·085	—	·040	—	—	·210	—		12
13	·555	·580	—	·190	—	—	·035	—	·005	·005	·010		13
14	·165	·160	—	·190	—	—	—	·380	—	—	·040		14
15	·460	·330	—	·060	·195	—	·015	—	·020	—	—		15
16	·475	—	—	·080	·240	—	—	—	·075	·085	—		16
17	·880	·005	—	·060	·035	—	—	—	—	—			17
18	·025	·010	—	—	·045	·400	—	—	·030	—			18
19	·080	—	—	—	·735	·320	—	—	·065	—			19
20	·935	·095	·120	·110	·105	·360	—	·010	—	—			20
21	·315	—	·155	·255	·215	·010	·030	—	·140	—			21
22	·095	—	—	—	·005	—	—	·005	·225	—			22
23	·135	—	·200	·440	·035	—	—	—	·015	·020			23
24	—	—	·025	·125	·435	—	—	·005	·110	—			24
25	—	—	·320	·095	—	—	—	—	·020	—			25
26	—	—	—	—	·080	—	—	—	·210	·110			26
27	—	—	·080	·025	—	·025	—	·220	·220	1·285			27
28	—	—	·050	·030	—	—	—	·200	·055	·085			28
29	·005		—	·060	—	—	—	·760	·835	·350			29
30	—		·105	—	—	·370	—	·005	·525	·530			30
31	—		·005		—		—	·040		—			31
Totals	7·900	5·775	1·345	2·865	2·240	1·485	0·710	1·805	2·750	4·350			
*	4·623	3·674	3·195	2·839	2·222	2·412	3·367	3·563	3·883	5·424	5·561	5·726	

* Mean monthly rainfall for 28 years, 1871 to 1898, as recorded at Falmouth Observatory.

No. 12.

COMPILATION of RETURNS of NOTIFIED CASES of CERTAIN INFECTIOUS DISEASES, and REGISTERED DEATHS therefrom.

1899.

APP. A, No. 12.

Compilation of Returns of Notified Infectious Diseases, and registered Deaths therefrom.

It should be noted, with reference to these returns, that some of the districts to which they apply administer compulsory notification under local Acts; and that not only are some of the diseases named in the Infectious Disease (Notification) Act of 1889 not notifiable under some of the local Acts, but that under certain of these Acts no payment is made for the notification of multiple attacks of the same disease occurring in the same house within a specified date of the first attack notified.

The Urban Districts finding place in these returns in which compulsory notification has been adopted under local Acts are—

Accrington.
Ashton-under-Lyne.
Birkenhead.
Blackburn.
Bolton.
Burnley.
Bury.
Cheltenham.
Chester.
Croydon.
Darwen.
Derby.
Grimsby.
Halifax.
Hartlepool.
Huddersfield.
Leicester.
Manchester.
Newcastle-on-Tyne.
Norwich.
Nottingham.
Oldham.
Portsmouth.
Preston.
Reading.
Rotherham.
Scarborough.
Stockton-on-Tees.
Sunderland.
Swansea.
Wakefield.
Warrington.
West Ham.
Wigan.
Willesden.
York.

App. A, No. 12.

Compilation of Returns of Notified Infectious Diseases, and registered Deaths therefrom.

No. 12.

TABLE showing Quarter by Quarter, during the Year 1899, for each
CASES and of REGISTERED DEATHS from the under-mentioned
each of the URBAN SANITARY DISTRICTS in question.

[The Cases are a Summary of the Weekly Returns of Notifiable Diseases received
Quarterly Returns of

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	SMALL-POX.									
			1st Quarter.		2nd Quarter.		3rd Quarter.		4th Quarter.		Total for 1899.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
I.	London .. .. .. (*Administrative County.*)	4,232,118	4	—	11	1	6	1	8	1	29	3
II. South-Eastern.	Croydon	102,695	—	—	—	—	—	—	—	—	—	—
	Dover	33,300	—	—	—	—	—	—	—	—	—	—
	Eastbourne	34,969	—	—	—	—	—	—	—	—	—	—
	Portsmouth	159,278	—	—	—	—	—	—	1	—	1	—
	Bournemouth	37,781	—	—	—	—	—	—	—	—	—	—
	Southampton	65,325	—	—	—	—	—	—	—	—	—	—
	Reading	60,054	—	—	—	—	—	—	—	—	—	—
III. South Midland.	Willesden	61,265	—	—	—	—	—	—	—	—	—	—
	Hornsey	44,205	—	—	5	—	—	—	—	—	5	—
	Tottenham	71,343	—	—	—	—	—	—	—	—	—	—
	Oxford	45,742	—	—	—	—	—	—	—	—	—	—
	Northampton	61,012	—	—	—	—	—	—	—	—	—	—
	Cambridge	36,983	—	—	—	—	—	—	—	—	—	—
IV. Eastern.	Leyton	63,056	—	—	—	—	—	—	—	—	—	—
	Walthamstow	46,346	—	—	—	—	—	—	—	—	—	—
	West Ham	204,903	2	—	—	—	—	—	—	—	2	—
	Colchester..	34,559	—	—	—	—	—	—	—	—	—	—
	Norwich	100,970	—	—	—	—	—	—	—	—	—	—
V. South-Western.	Exeter	37,404	—	—	1	—	—	—	—	—	1	—
	Plymouth	84,248	—	—	—	—	—	—	—	—	—	—
	Devonport	54,803	—	—	—	—	—	—	—	—	—	—
	Bath..	51,844	—	—	—	—	—	—	—	—	—	—
VI. West Midland.	Bristol	268,296	—	—	—	—	—	—	—	—	—	—
	Gloucester..	39,444	—	—	—	—	—	—	—	—	—	—
	Cheltenham	47,514	—	—	—	—	—	—	—	—	—	—
	Hanley	54,946	—	—	—	—	—	—	—	—	—	—
	Longton	34,327	—	—	—	—	—	—	—	—	—	—
	Burton-on-Trent ..	46,047	—	—	—	—	—	—	—	—	—	—
	Wolverhampton ..	82,662	—	—	—	—	—	—	—	—	—	—
	Walsall	71,789	—	—	—	—	—	—	—	—	—	—
	West Bromwich.. ..	59,474	—	—	—	—	—	—	—	—	—	—
	Worcester	42,908	—	—	—	—	—	—	—	—	—	—
	Smethwick	36,170	—	—	—	—	—	—	—	—	—	—
	Birmingham	478,113	—	—	—	—	—	—	—	—	—	—
	Aston Manor	68,639	—	—	—	—	—	—	—	—	—	—
	Coventry	52,724	—	—	—	—	—	—	—	—	—	—
VII. North Midland.	Leicester	174,624	—	—	—	—	—	—	—	—	—	—
	Grimsby	51,934	—	—	1	—	10	2	7	1	18	3
	Nottingham	213,877	—	—	—	—	—	—	—	—	—	—
	Derby	94,146	—	—	—	—	—	—	—	—	—	—

No. 12.

of 93 URBAN SANITARY DISTRICTS, the NUMBER of NOTIFIED DISEASES, together with an ANNUAL SUMMARY of these data for

by the Board from Medical Officers of Health. The Deaths are extracted from the the Registrar-General.]

APP. A, No. 12.

Compilation of Returns of Notified Infectious Diseases, and registered Deaths therefrom.

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	SMALL-POX—*continued*.									
			1st Quarter.		2nd Quarter.		3rd Quarter.		4th Quarter.		Total for 1899.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
VIII. North-Western.	Stockport	70,283	—	—	—	—	—	—	—	—	—	—
	Macclesfield	36,000	—	—	—	—	—	—	—	—	—	—
	Chester	37,105	—	—	—	—	—	—	—	—	—	—
	Birkenhead	99,857	—	—	—	—	—	—	—	—	—	—
	Wallasey	33,229	—	—	—	—	—	—	—	—	—	—
	Bootle	49,217	—	—	—	—	—	—	—	—	—	—
	Liverpool	629,443	3	—	7	1	—	—	—	—	10	1
	St. Helens (Lancs.) ..	71,288	—	—	—	—	—	—	—	—	—	—
	Southport	41,406	—	—	—	—	—	—	—	—	—	—
	Wigan	55,013	—	—	—	—	—	—	—	—	—	—
	Warrington	52,743	—	—	—	—	—	—	—	—	—	—
	Bolton	115,002	—	—	—	—	—	—	—	—	—	—
	Bury (Lancs.)	57,212	—	—	—	—	—	—	—	—	—	—
	Salford	198,139	—	—	—	—	—	—	—	—	—	—
	Manchester	505,368	—	—	1	—	1	—	—	—	2	—
	Ashton-under-Lyne ..	40,463	—	—	—	—	—	—	—	—	—	—
	Oldham	131,463	—	—	2	—	—	—	—	—	2	—
	Rochdale	71,401	—	—	—	—	—	—	—	—	—	—
	Accrington	38,603	—	—	1	—	—	—	—	—	1	—
	Burnley	87,016	—	—	—	—	—	—	—	—	—	—
	Blackburn	120,064	—	—	—	—	—	—	—	—	—	—
	Darwen	34,192	—	—	—	—	—	—	—	—	—	—
	Preston	107,573	—	—	—	—	—	—	—	—	—	—
	Barrow-in-Furness ...	51,712	—	—	—	—	—	—	—	—	—	—
IX. Yorkshire.	Keighley	30,810	—	—	—	—	—	—	—	—	—	—
	Huddersfield	95,420	—	—	—	—	—	—	—	—	—	—
	Halifax	89,832	—	—	—	—	—	—	—	—	—	—
	Bradford	216,361	—	—	—	—	—	—	4	—	4	—
	Leeds	367,505	—	—	—	—	—	—	1	—	1	—
	Wakefield	33,146	—	—	—	—	—	—	—	—	—	—
	Barnsley	35,427	—	—	—	—	—	—	—	—	—	—
	Sheffield	324,243	—	—	—	—	—	—	1	—	1	—
	Rotherham	42,061	—	—	—	—	—	—	2	—	2	—
	York	67,004	—	—	—	—	—	—	2	—	2	—
	Hull	200,044	9	—	91	19	141	23	599	99	843	141
	Scarborough	33,776	—	—	—	—	—	—	—	—	—	—
	Middlesbrough	75,532	—	—	—	—	1	—	—	—	1	—
X. Northern.	Darlington	38,060	—	—	—	—	—	—	—	—	—	—
	Stockton-on-Tees ..	49,705	—	—	1	—	—	—	—	—	1	—
	West Hartlepool ..	42,710	—	—	—	—	—	—	—	—	—	—
	Sunderland	131,015	2	—	—	—	—	—	—	—	2	—
	Jarrow	33,675	—	—	—	—	—	—	—	—	—	—
	South Shields	78,391	2	—	—	—	—	—	—	—	2	—
	Gateshead	85.692	—	—	—	—	—	—	—	—	—	—
	Newcastle-on-Tyne ..	186,300	—	—	—	—	—	—	—	—	—	—
	Tynemouth	46,588	—	—	—	—	—	—	—	—	—	—
	Carlisle	39,176	—	—	—	—	—	—	—	—	—	—
XI. Welsh.	Newport (Mon.)	54,707	—	—	—	—	—	—	—	—	—	—
	Cardiff	128,915	—	—	—	—	—	—	—	—	—	—
	Rhondda	88,351	—	—	—	—	—	—	—	—	—	—
	Merthyr Tydfil	58,060	—	—	—	—	—	—	—	—	—	—
	Swansea	90,349	1	—	—	—	—	—	—	—	1	—
	Totals, 93 Districts ..	13,128,484	23	—	121	21	162	26	625	101	931	148

App. A, No. 12.

Compilation of Returns of Notified Infectious Diseases, and registered Deaths therefrom.

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	SCARLET FEVER.									
			1st Quarter.		2nd Quarter.		3rd Quarter.		4th Quarter.		Total for 1899.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
I.	London .. .. .. (*Administrative County.*)	4,232,118	3,947	96	4,015	84	4,770	87	5,386	131	18,118	398
II. South-Eastern.	Croydon	102,695	99	2	77	1	67	—	107	—	350	3
	Dover	33,300	115	4	99	3	68	—	122	5	404	12
	Eastbourne	34,969	18	—	12	—	6	—	28	—	64	—
	Portsmouth	159,278	209	9	170	6	124	3	76	3	579	21
	Bournemouth	37,781	63	—	81	4	49	1	89	—	282	5
	Southampton	65,325	92	—	52	—	62	—	91	—	297	—
	Reading	60,054	30	—	41	—	27	1	41	1	139	2
III. South Midland.	Willesden	61,265	82	4	72	—	99	3	162	10	415	17
	Hornsey	44,205	30	—	73	2	60	1	180	1	343	4
	Tottenham	71 343	124	4	88	5	117	1	140	4	469	14
	Oxford	45,742	8	—	11	—	4	—	17	—	40	—
	Northampton	61,012	133	2	74	2	80	3	51	2	338	9
	Cambridge	36,983	62	—	43	—	41	1	13	—	159	1
IV. Eastern.	Leyton	63,056	100	—	50	—	75	2	88	—	313	2
	Walthamstow ..	46,346	70	1	44	1	87	—	135	4	336	6
	West Ham	204,903	214	9	148	4	203	—	234	6	799	19
	Colchester	34,559	12	1	20	—	16	—	47	—	95	1
	Norwich	100,970	144	7	88	6	72	4	53	1	357	18
V. South-Western.	Exeter	37,404	20	1	19	1	12	1	47	—	98	3
	Plymouth	84,248	142	1	63	—	23	2	23	—	251	3
	Devonport	54,803	98	—	48	—	38	—	20	—	204	—
	Bath	51,844	6	—	11	—	23	—	17	1	57	1
VI. West Midland.	Bristol	258,206	138	2	126	2	162	3	291	6	717	13
	Gloucester	39,444	41	—	31	1	12	—	21	—	105	1
	Cheltenham	47,514	80	3	80	1	30	1	78	1	268	6
	Hanley	54,946	130	4	105	6	168	4	248	17	651	31
	Longton	34,327	121	7	147	7	142	5	73	7	483	26
	Burton-on-Trent ..	46,047	97	2	88	2	76	2	61	1	322	7
	Wolverhampton ..	82,662	43	1	44	1	50	3	45	1	182	6
	Walsall	71,789	48	2	35	—	19	1	40	1	142	4
	West Bromwich ..	59,474	43	2	46	2	51	2	68	3	208	9
	Worcester	42,908	57	1	55	1	79	2	99	1	290	5
	Smethwick	36,170	24	—	33	1	114	1	109	2	280	4
	Birmingham	478,113	264	14	238	2	346	8	409	6	1,257	30
	Aston Manor	68,639	27	—	26	1	44	1	30	—	127	2
	Coventry	52,724	26	2	37	1	22	—	87	1	172	4
VII. North Midland.	Leicester	174,624	289	7	300	9	326	11	415	16	1,330	43
	Grimsby	51,934	30	—	39	—	40	1	44	1	153	2
	Nottingham	213,877	509	11	620	13	620	13	807	20	2,556	56
	Derby	94,146	227	12	262	5	159	6	241	2	889	25

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	SCARLET FEVER—*continued.*									
			1st Quarter.		2nd Quarter.		3rd Quarter.		4th Quarter.		Total for 1899.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
VIII. North-Western.	Stockport	70,263	18	—	25	1	10	2	40	2	93	5
	Macclesfield	36,000	125	4	63	2	23	1	29	1	240	8
	Chester	37,105	23	—	70	2	56	2	46	1	195	5
	Birkenhead	99,857	67	3	48	1	31	2	50	1	196	7
	Wallasey	33,229	64	—	23	3	36	—	41	2	164	5
	Bootle	49,217	46	1	30	3	43	1	79	6	198	11
	Liverpool	629,443	705	43	624	33	404	41	616	45	2,439	162
	St. Helens (Lancs.) ..	71,288	111	3	77	1	69	1	81	3	338	8
	Southport	41,406	45	2	28	—	24	—	80	4	177	6
	Wigan	55,013	72	9	74	4	58	4	45	2	249	19
	Warrington	52,743	62	4	130	6	189	8	126	8	507	26
	Bolton	115,002	208	5	322	14	299	5	397	11	1.226	35
	Bury (Lancs.)	57 212	20	—	11	1	39	—	160	4	230	5
	Salford	198,139	176	15	138	6	177	12	236	16	727	49
	Manchester	505,368	162	8	258	10	393	8	672	19	1,485	45
	Ashton-under-Lyne ..	40,463	32	1	38	1	52	—	47	—	169	2
	Oldham	131,463	171	9	115	6	204	15	331	16	821	46
	Rochdale	71,401	36	1	59	3	57	2	55	6	207	12
	Accrington	38,603	82	6	136	2	106	1	80	1	404	10
	Burnley	87,016	145	7	424	22	384	27	379	20	1,332	76
	Blackburn	120,064	170	7	134	6	99	1	210	9	613	23
	Darwen	34,192	94	4	70	3	122	8	115	6	401	21
	Preston	107,573	18	—	27	1	102	4	170	6	317	11
	Barrow-in-Furness ..	51,712	14	—	13	—	23	—	214	4	264	4
IX. Yorkshire.	Keighley	30,810	42	1	89	3	77	4	153	9	361	17
	Huddersfield	95,420	79	2	105	2	67	1	82	1	333	6
	Halifax	89,832	175	6	207	8	227	10	152	2	761	26
	Bradford	216,361	517	15	641	36	549	27	550	28	2,287	106
	Leeds	367,505	379	16	348	16	413	18	467	14	1,607	64
	Wakefield	33,146	16	—	17	—	29	2	39	—	101	2
	Barnsley	35,427	33	3	31	1	18	1	69	4	151	9
	Sheffield	324,243	397	26	436	16	499	25	655	24	1,987	91
	Rotherham	42,061	48	3	49	—	65	5	72	6	234	14
	York	67,004	44	1	43	—	49	1	64	1	200	3
	Hull	200,044	154	6	256	9	241	5	383	19	1,034	39
	Scarborough	33,776	37	—	11	—	16	1	24	2	88	3
	Middlesbrough ..	75,532	60	—	58	5	97	3	131	5	346	13
X. Northern.	Darlington	38,060	17	—	25	2	53	1	144	8	239	11
	Stockton-on-Tees ..	49,705	27	—	29	—	42	—	69	3	167	3
	West Hartlepool ..	42,710	4	—	10	—	13	1	13	—	40	1
	Sunderland	131,015	237	8	239	6	184	7	302	15	962	36
	Jarrow	33,675	53	4	51	3	52	1	73	3	229	11
	South Shields	78,391	190	3	106	5	106	5	268	4	670	17
	Gateshead	85,692	146	6	56	1	75	3	63	3	340	13
	Newcastle-on-Tyne ..	186,300	108	5	91	5	153	5	268	11	620	26
	Tynemouth	46,588	6	—	10	—	4	—	38	1	58	1
	Carlisle	39,176	5	—	4	—	19	1	32	1	60	2
XI. Welsh.	Newport (Mon.) ..	54,707	21	2	13	—	4	—	8	—	46	2
	Cardiff	128,915	42	—	32	—	42	—	69	3	185	3
	Rhondda	88,351	186	—	185	1	52	3	111	4	534	8
	Merthyr Tydfil ..	58,080	15	—	21	—	8	1	9	—	53	1
	Swansea	90,349	63	4	46	3	49	3	111	1	269	11
	Totals, 93 Districts	13,128,484	13,809	454	13,857	427	14,876	452	19,001	620	61,543	1,953

App. A, No. 12.

Compilation of Returns of Notified Infectious Diseases, and registered Deaths therefrom.

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	DIPHTHERIA.									
			1st Quarter.		2nd Quarter.		3rd Quarter.		4th Quarter.		Total for 1899.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
I.	London .. .. .. (*Administrative County.*)	4,232,118	2,867	472	2,799	357	3,652	438	4,051	696	13,369	1,963
II. South-Eastern.	Croydon	102,695	27	4	17	5	37	3	43	5	124	17
	Dover	33,300	3	—	4	—	3	—	5	2	15	2
	Eastbourne	34,969	7	1	8	1	16	1	16	3	47	6
	Portsmouth	159,278	129	32	116	27	102	16	219	46	566	121
	Bournemouth.. ..	37,781	7	1	27	—	16	1	15	2	65	4
	Southampton	65,325	67	23	44	12	26	5	53	9	190	49
	Reading..	60,054	3	—	4	2	5	2	12	5	24	9
III. South Midland.	Willesden	61,265	86	17	70	11	71	6	93	12	320	46
	Hornsey..	44,205	19	1	16	1	32	2	31	1	98	5
	Tottenham	71,343	60	10	38	8	44	3	35	3	177	24
	Oxford	45,742	12	—	5	—	13	1	59	2	89	3
	Northampton.. ..	61,012	1	3	6	2	2	2	—	1	9	8
	Cambridge	36,983	2	1	7	1	4	1	1	—	14	3
IV. Eastern.	Leyton	63,056	34	5	44	11	53	9	62	8	193	33
	Walthamstow ..	46,346	34	12	54	17	72	13	180	34	340	76
	West Ham	204,903	364	55	279	37	287	41	357	50	1,287	183
	Colchester	34,559	15	5	1	—	12	2	12	2	40	9
	Norwich	100,970	40	11	25	6	29	7	29	16	123	40
V. South-Western.	Exeter	37,404	2	—	3	—	1	—	3	2	9	2
	Plymouth	84,248	11	4	11	5	6	3	20	8	48	20
	Devonport	54,803	6	—	1	1	6	2	8	1	21	4
	Bath	51,844	8	3	3	—	7	3	16	3	34	9
VI. West Midland.	Bristol	258,296	63	10	40	3	37	7	65	13	205	33
	Gloucester	39,444	13	—	6	—	9	—	7	3	35	3
	Cheltenham	47,514	18	1	14	—	22	4	26	7	80	12
	Hanley	54,946	20	7	29	6	80	18	90	16	219	47
	Longton	34,327	42	4	38	5	32	3	26	1	138	13
	Burton-on-Trent ..	46,047	2	1	7	1	13	2	18	4	40	8
	Wolverhampton ..	82,662	27	4	22	3	28	4	28	6	105	17
	Walsall	71,789	4	1	11	2	7	2	8	6	30	11
	West Bromwich ..	59,474	1	1	4	2	4	—	4	1	13	4
	Worcester	42,908	27	2	33	3	31	1	44	6	135	12
	Smethwick	36,170	18	2	7	—	10	3	12	3	47	8
	Birmingham	478,113	162	34	136	28	190	37	183	48	671	147
	Aston Manor	68,639	13	4	13	2	18	10	26	4	70	20
	Coventry	52,724	10	8	5	2	7	3	15	2	37	15
VII. North Midland.	Leicester	174,624	146	42	230	68	272	55	277	62	925	227
	Grimsby	51,934	25	3	22	1	19	5	83	23	149	32
	Nottingham	213,877	40	11	23	4	37	9	42	8	142	32
	Derby	94,146	18	1	18	5	10	2	14	—	60	8

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	DIPHTHERIA—*continued.*									
			1st Quarter.		2nd Quarter.		3rd Quarter.		4th Quarter.		Total for 1890.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
VIII. North-Western.	Stockport	70,263	2	1	3	—	1	—	1	3	7	4
	Macclesfield	36,000	6	1	1	—	4	—	3	—	14	1
	Chester	37,105	19	2	9	2	6	—	11	2	45	6
	Birkenhead	99,857	41	13	15	6	11	3	22	2	89	24
	Wallasey	33,229	9	—	10	5	4	1	11	4	34	10
	Bootle	49,217	8	4	11	4	12	4	6	3	37	15
	Liverpool	629,443	282	65	123	36	144	49	209	62	758	212
	St. Helens (Lancs.)	71,288	13	4	12	2	6	1	25	6	56	13
	Southport	41,406	18	2	14	2	8	1	2	1	42	6
	Wigan	55,013	2	1	5	—	—	1	6	4	13	6
	Warrington	52,743	3	1	5	3	2	2	5	2	15	8
	Bolton	115,002	13	4	12	4	14	5	11	1	50	14
	Bury (Lancs.) ..	57,212	18	4	7	3	3	—	11	1	39	8
	Salford	198,139	46	19	39	16	47	15	72	25	204	75
	Manchester	505,368	55	16	64	16	36	17	97	34	252	83
	Ashton-under-Lyne	40,463	—	—	—	—	1	1	5	—	6	1
	Oldham	131,463	18	11	16	7	16	3	21	3	71	24
	Rochdale	71,401	6	8	4	3	6	1	4	1	20	13
	Accrington	38,603	10	1	8	4	3	1	7	2	28	8
	Burnley	87,016	45	7	26	9	19	4	19	6	109	26
	Blackburn	120,064	51	18	24	11	60	10	78	33	213	72
	Darwen	34,192	6	2	4	3	1	—	—	—	11	5
	Preston	107,573	2	1	11	5	46	17	58	16	117	39
	Barrow-in-Furness	51,712	9	2	8	5	5	—	13	5	35	12
IX. Yorkshire.	Keighley	30,810	8	2	10	2	15	2	9	2	42	8
	Huddersfield ..	95,420	6	2	6	2	8	1	6	—	26	5
	Halifax	89,832	5	3	18	5	23	3	13	4	59	15
	Bradford	216,361	21	7	21	6	15	4	30	10	87	27
	Leeds	367,505	479	83	272	54	441	79	570	112	1,762	328
	Wakefield	33,146	3	6	3	1	7	1	6	2	19	10
	Barnsley	35,427	6	—	2	1	5	2	7	4	20	7
	Sheffield	324,243	331	83	457	98	575	105	856	174	2,219	460
	Rotherham	42,061	5	2	3	3	7	2	—	1	15	8
	York	67,004	10	1	—	—	9	3	9	—	28	4
	Hull	200,044	40	14	30	5	24	4	63	6	157	29
	Scarborough ..	33,776	22	4	13	3	6	3	15	5	56	15
	Middlesbrough ..	75,532	6	2	6	1	13	4	6	3	31	10
X. Northern.	Darlington	38,060	2	—	2	2	2	—	4	1	10	3
	Stockton-on-Tees ..	49,705	4	1	1	—	2	1	10	4	17	6
	West Hartlepool ..	42,710	1	1	3	1	2	2	5	3	11	7
	Sunderland	131,015	7	6	3	—	5	1	6	2	21	9
	Jarrow	33,675	5	2	1	—	5	2	2	1	13	5
	South Shields ..	78,391	8	2	6	—	3	2	11	—	28	4
	Gateshead	85,692	7	1	3	4	1	1	7	2	18	8
	Newcastle-on-Tyne	186,300	30	5	14	5	35	11	28	8	107	29
	Tynemouth	46,588	4	5	—	—	8	1	15	2	27	8
	Carlisle	39,176	5	1	1	—	14	1	6	1	26	3
XI. Welsh.	Newport (Mon.) ..	54,707	3	1	11	5	7	1	7	3	28	10
	Cardiff	128,915	226	19	108	6	132	18	153	18	619	61
	Rhondda	88,351	580	43	463	53	433	46	329	35	1,805	177
	Merthyr Tydfil ..	58,080	19	9	9	5	51	13	20	9	99	36
	Swansea	90,349	312	58	259	39	118	26	149	18	838	141
	Totals, 93 Districts	13,128,484	7,290	1,346	6,396	1,086	7,743	1,201	9,327	1,770	30,756	5,403

App. A, No. 12.

Compilation of Returns of Notified Infectious Diseases, and registered Deaths therefrom.

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	"FEVER."									
			1st Quarter.					2nd Quarter.				
			Notifications					Notifications.				
			Typhus.	Enteric.	Continued.	Total.	Deaths.	Typhus.	Enteric.	Continued.	Total.	Deaths.
I.	London .. .. .. (*Administrative County.*)	4,232,118	7	787	16	810	158	1	447	11	459	88
II. South-Eastern.	Croydon	102,695	—	7	—	7	1	—	3	—	3	—
	Dover	33,300	—	5	—	5	1	—	3	—	3	2
	Eastbourne	34,969	—	—	—	—	—	—	3	—	3	—
	Portsmouth	159,278	—	35	7	42	12	—	70	30	83	11
	Bournemouth	37,781	—	1	—	1	—	—	2	—	2	—
	Southampton	65,325	—	19	1	20	1	—	11	—	11	1
	Reading	60,054	—	9	—	9	3	—	10	—	10	3
III. South Midland.	Willesden	61,265	—	14	—	14	2	—	9	—	9	—
	Hornsey	44,205	—	1	—	1	—	—	3	—	3	—
	Tottenham	71,343	—	22	—	22	1	—	15	—	15	2
	Oxford	45,742	—	2	—	2	—	—	1	—	1	—
	Northampton	61,012	—	16	—	16	1	—	12	—	12	6
	Cambridge	36,983	—	9	—	9	—	—	1	—	1	—
IV. Eastern.	Leyton	63,056	—	9	—	9	—	—	11	1	12	—
	Walthamstow	46,346	—	19	—	19	5	—	13	—	13	3
	West Ham	204,903	—	89	—	89	12	—	49	—	49	12
	Colchester	34,559	—	4	—	4	1	—	8	—	8	2
	Norwich	100,970	—	26	—	26	2	—	25	—	25	4
V. South-Western.	Exeter	37,404	—	39	3	42	4	—	33	1	34	5
	Plymouth	84,248	—	16	—	16	2	—	8	—	8	1
	Devonport	54,803	—	9	—	9	1	—	7	—	7	2
	Bath	51,844	—	4	—	4	—	—	8	—	8	4
VI. West Midland.	Bristol	258,296	2	36	—	38	9	—	27	1	28	6
	Gloucester	39,444	—	3	—	3	2	—	4	—	4	2
	Cheltenham	47,514	—	6	—	6	—	—	4	—	4	1
	Hanley	54,946	1	50	2	53	11	—	22	2	24	1
	Longton	34,327	—	15	—	15	5	—	10	—	10	3
	Burton-on-Trent ..	46,047	—	13	—	13	3	—	7	—	7	3
	Wolverhampton ..	82,662	—	71	—	71	14	—	43	—	43	12
	Walsall	71,789	—	21	—	21	2	—	12	—	12	4
	West Bromwich ..	59,474	—	13	—	13	6	—	7	—	7	4
	Worcester	42,908	—	4	—	4	—	—	1	—	1	—
	Smethwick	36,170	—	12	—	12	1	—	8	—	8	1
	Birmingham	478,113	—	154	1	155	31	—	103	7	110	22
	Aston Manor	68,639	—	45	—	45	6	—	21	—	21	10
	Coventry	52,724	—	19	2	21	4	—	28	—	28	2
VII. North Midland.	Leicester	174,624	—	36	—	36	4	—	18	—	18	—
	Grimsby	51,934	—	6	1	7	4	—	18	1	19	2
	Nottingham	213,877	—	95	—	95	15	—	47	—	47	7
	Derby	94,146	—	39	—	39	6	—	17	—	17	3

APP. A, No. 12.

Compilation of Returns of Notified Infectious Diseases and registered Deaths therefrom.

"FEVER."															Urban Sanitary Districts.
3rd Quarter.					4th Quarter.					Totals for 1899.					
Notifications.				Deaths.	Notifications.				Deaths.	Notifications.				Deaths.	
Typhus.	Enteric.	Continued.	Total.		Typhus.	Enteric.	Continued.	Total.		Typhus.	Enteric.	Continued.	Total.		
2	1,073	22	1,097	177	2	2,157	20	2,179	381	12	4,464	69	4,545	804	London. (*Administrative County.*)
—	21	—	21	—	—	26	1	27	8	—	57	1	58	8	Croydon.
—	3	—	3	1	—	6	—	6	2	—	17	—	17	6	Dover.
—	4	—	4	1	—	15	—	15	3	—	22	—	22	4	Eastbourne.
—	262	13	275	29	—	155	6	161	24	—	522	39	561	76	Portsmouth.
—	3	—	3	—	—	1	—	1	—	—	7	—	7	—	Bournemouth.
—	111	6	117	10	—	40	—	40	6	—	181	7	188	18	Southampton.
—	10	—	10	2	—	6	—	6	1	—	35	—	35	9	Reading.
—	27	—	27	4	—	28	—	28	2	—	78	—	78	8	Willesden.
—	7	—	7	—	—	11	—	11	—	—	22	—	22	—	Hornsey.
—	29	1	30	—	—	47	—	47	5	—	113	1	114	8	Tottenham.
—	4	—	4	—	—	4	—	4	—	—	11	—	11	—	Oxford.
—	7	—	7	1	—	12	—	12	2	—	47	—	47	10	Northampton.
—	18	—	18	—	—	13	—	13	—	—	41	—	41	—	Cambridge.
1	32	3	36	2	—	55	—	55	6	1	107	4	112	8	Leyton.
—	28	—	28	4	—	67	1	68	8	—	127	1	128	20	Walthamstow.
—	115	2	117	10	—	214	1	215	43	—	467	3	470	77	West Ham.
—	8	—	8	—	—	7	—	7	1	—	27	—	27	4	Colchester.
—	60	—	60	9	—	31	—	31	5	—	142	—	142	20	Norwich.
—	99	—	99	7	—	15	—	15	2	—	186	4	190	18	Exeter.
—	17	—	17	—	—	9	—	9	4	—	50	—	50	7	Plymouth.
—	11	—	11	4	—	6	—	6	2	—	33	—	33	9	Devonport.
—	23	1	24	3	—	13	1	14	3	—	48	2	50	10	Bath.
—	59	—	59	8	—	100	—	100	11	2	222	1	225	34	Bristol.
—	2	—	2	1	—	3	—	3	1	—	12	—	12	6	Gloucester.
—	4	—	4	1	—	2	—	2	2	—	16	—	16	4	Cheltenham.
—	26	3	29	2	—	45	7	52	12	1	143	14	158	26	Hanley.
—	18	—	18	1	—	14	—	14	2	—	57	—	57	11	Longton.
—	7	1	8	1	—	9	—	9	2	—	36	1	37	9	Burton-on-Trent.
—	28	1	29	4	—	64	1	65	16	—	206	2	208	46	Wolverhampton.
—	19	—	19	2	—	26	—	26	6	—	78	—	78	14	Walsall.
—	12	—	12	5	—	25	—	25	4	—	57	—	57	19	West Bromwich.
—	4	—	4	—	—	15	1	16	1	—	24	1	25	1	Worcester.
—	14	2	16	—	—	27	1	28	5	—	61	3	64	7	Smethwick.
—	118	1	119	18	—	427	5	432	54	—	802	14	816	125	Birmingham.
—	28	—	28	3	—	89	1	90	14	—	183	1	184	33	Aston Manor.
—	50	4	54	8	—	30	2	32	6	—	127	8	135	20	Coventry.
—	45	—	45	10	—	66	—	66	15	—	165	—	165	29	Leicester.
—	162	5	167	8	—	111	3	114	12	—	297	10	307	26	Grimsby.
—	156	—	156	21	—	313	—	313	72	—	611	—	611	115	Nottingham.
—	26	—	26	1	—	60	—	60	5	—	142	—	142	15	Derby.

App. A, No. 12.

Compilation of Returns of Notified Infectious Diseases, and registered Deaths therefrom.

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	"Fever."									
			1st Quarter.					2nd Quarter.				
			Notifications.					Notifications.				
			Typhus.	Enteric.	Continued.	Total.	Deaths.	Typhus.	Enteric.	Continued.	Total.	Deaths.
VIII. North-Western.	Stockport	70,263	—	19	—	19	3	—	5	—	5	2
	Macclesfield	36,000	—	1	—	1	—	—	7	—	7	3
	Chester	37,105	—	27	—	27	5	—	7	—	7	1
	Birkenhead	99,857	—	37	—	37	7	—	30	—	30	7
	Wallasey	33,229	—	11	—	11	—	—	18	—	18	2
	Bootle	49,217	—	6	—	6	1	1	16	—	17	4
	Liverpool	629,443	29	210	10	249	33	7	235	14	256	53
	St. Helens (Lancs.) ..	71,288	—	29	1	30	12	—	20	—	20	3
	Southport	41,406	—	3	—	3	—	—	7	—	7	1
	Wigan	55,013	—	51	—	51	6	—	18	—	18	3
	Warrington	52,743	—	2	—	2	1	—	5	—	5	—
	Bolton	115,002	—	88	—	88	16	—	32	—	32	5
	Bury (Lancs.)	57,212	—	17	7	24	5	—	7	—	7	2
	Salford	198,139	—	84	9	93	13	—	52	5	57	13
	Manchester	505,368	—	136	—	136	21	—	71	—	71	11
	Ashton-under-Lyne ..	40,463	—	12	—	12	2	—	3	—	3	1
	Oldham	131,463	—	18	—	18	4	—	14	—	14	5
	Rochdale	71,401	—	11	—	11	3	—	6	2	8	3
	Accrington	38,603	—	13	—	13	—	—	5	—	5	2
	Burnley	87,016	—	31	—	31	9	—	22	—	22	2
	Blackburn	120,064	—	89	—	89	10	—	28	—	28	7
	Darwen	34,192	—	16	—	16	3	—	16	—	16	6
	Preston	107,573	—	70	—	70	15	—	25	—	25	5
	Barrow-in-Furness ..	51,712	—	8	4	12	5	—	8	1	9	—
IX. Yorkshire.	Keighley	30,810	—	16	—	16	2	—	6	—	6	1
	Huddersfield	95,420	—	10	—	10	3	—	8	—	8	5
	Halifax	89,832	—	19	—	19	5	—	12	1	13	5
	Bradford	216,361	—	88	—	88	15	—	31	—	31	10
	Leeds	367,505	—	103	6	109	16	—	64	4	68	13
	Wakefield	33,146	—	16	—	16	3	—	4	—	4	1
	Barnsley	35,427	—	17	—	17	1	—	9	—	9	3
	Sheffield	324,243	—	220	2	222	40	—	95	—	95	16
	Rotherham	42,061	—	15	—	15	2	—	16	—	16	3
	York	67,004	—	14	—	14	3	—	10	—	10	—
	Hull	200,044	—	29	10	39	3	—	19	2	21	3
	Scarborough	33,776	—	6	—	6	1	—	17	—	17	2
	Middlesbrough	75,532	—	38	—	38	3	2	30	1	33	9
X. Northern.	Darlington	38,060	—	7	1	8	2	—	4	—	4	—
	Stockton-on-Tees ..	49,705	—	21	5	26	1	—	14	2	16	4
	West Hartlepool ..	42,710	—	5	—	5	3	—	5	—	5	1
	Sunderland	131,015	—	35	14	49	9	—	37	6	43	12
	Jarrow	33,675	—	9	—	9	—	—	6	—	6	2
	South Shields	78,391	—	60	1	61	15	—	30	—	30	12
	Gateshead	85,692	—	9	—	9	4	—	22	—	22	3
	Newcastle-on-Tyne ..	186,300	—	33	—	33	3	1	12	2	15	1
	Tynemouth	46,588	—	4	—	4	—	—	5	—	5	—
	Carlisle	39,176	—	3	—	3	1	—	7	—	7	—
XI. Welsh.	Newport (Mon.) ..	54,707	—	22	1	23	4	—	6	5	11	2
	Cardiff	128,915	—	11	—	11	—	—	9	1	10	2
	Rhondda	88,351	—	65	3	68	10	—	28	8	36	7
	Merthyr Tydfil	58,080	—	42	—	42	6	—	61	1	62	6
	Swansea	90,349	—	18	1	19	1	—	19	—	19	2
	Totals, 93 Districts ..	13,128,484	39	3,704	108	3,851	662	12	2,392	92	2,496	495

Compilation of Returns of Notified Infectious Diseases, and registered Deaths therefrom.

"FEVER."

3rd Quarter. Notifications. Typhus.	3rd Quarter. Notifications. Enteric.	3rd Quarter. Notifications. Continued.	3rd Quarter. Notifications. Total.	3rd Quarter. Deaths.	4th Quarter. Notifications. Typhus.	4th Quarter. Notifications. Enteric.	4th Quarter. Notifications. Continued.	4th Quarter. Notifications. Total.	4th Quarter. Deaths.	Totals for 1899. Notifications. Typhus.	Totals for 1899. Notifications. Enteric.	Totals for 1899. Notifications. Continued.	Totals for 1899. Notifications. Total.	Totals for 1899. Deaths.	Urban Sanitary Districts.
—	18	—	18	2	—	19	—	19	1	—	61	—	61	8	Stockport.
—	19	—	19	1	—	8	—	8	—	—	35	—	35	4	Macclesfield.
—	8	—	8	1	—	12	—	12	3	—	54	—	51	10	Chester.
1	107	—	108	19	—	99	—	99	16	1	273	—	274	49	Birkenhead.
—	43	—	43	3	—	58	—	58	6	—	130	—	130	11	Wallasey.
—	25	—	25	5	—	29	—	29	6	1	76	—	77	16	Bootle.
4	255	6	265	48	29	310	17	356	65	69	1,010	47	1,126	199	Liverpool.
—	117	—	117	23	—	54	—	54	10	—	220	1	221	48	St. Helens (Lancs.).
—	10	—	10	2	—	24	—	24	6	—	44	—	44	9	Southport.
—	63	—	63	8	—	42	—	42	7	—	174	—	174	24	Wigan.
—	83	—	83	9	—	58	—	58	13	—	148	—	148	23	Warrington.
—	91	—	91	11	—	109	—	109	24	—	320	—	320	56	Bolton.
—	9	2	11	4	—	12	3	15	3	—	45	12	57	14	Bury (Lancs.).
—	99	11	110	28	1	93	6	99	23	1	328	30	359	77	Salford.
2	93	—	95	20	2	117	—	119	22	4	417	—	421	77	Manchester.
—	14	—	14	4	—	21	2	23	1	—	50	2	52	8	Ashton-under-Lyne.
—	23	—	23	5	—	37	—	37	5	—	92	—	92	19	Oldham.
—	7	—	7	3	—	7	1	8	1	—	31	3	34	10	Rochdale.
—	5	—	5	1	—	12	—	12	1	—	35	—	35	4	Accrington.
—	64	—	64	10	—	22	—	22	4	—	139	—	139	25	Burnley.
—	41	—	41	11	1	82	—	83	13	1	240	—	241	41	Blackburn.
—	6	—	6	2	—	17	—	17	1	—	55	—	55	12	Darwen.
—	45	—	45	4	—	83	—	83	15	—	223	—	223	39	Preston.
—	24	3	27	8	—	15	5	20	4	—	55	13	68	17	Barrow-in-Furness.
—	18	—	18	3	—	13	—	13	4	—	53	—	53	10	Keighley.
—	30	—	30	9	—	22	—	22	4	—	70	—	70	21	Huddersfield.
—	30	1	31	6	—	30	—	30	8	—	91	2	93	24	Halifax.
—	54	1	55	8	—	83	1	84	13	—	256	2	258	46	Bradford.
—	165	1	166	18	—	160	1	161	24	—	492	12	504	71	Leeds.
—	7	—	7	1	—	18	—	18	5	—	45	—	45	10	Wakefield.
—	24	—	24	5	—	24	—	24	3	—	74	—	74	12	Barnsley.
—	427	2	429	51	—	419	—	419	78	—	1,161	4	1,165	185	Sheffield.
—	33	—	33	8	—	35	2	37	7	—	99	2	101	20	Rotherham.
—	70	—	70	7	—	40	—	40	12	—	134	—	134	22	York.
—	138	7	145	17	—	85	7	92	19	—	271	26	297	42	Hull.
—	32	—	32	5	—	18	—	18	2	—	73	—	73	10	Scarborough.
—	41	1	42	7	—	28	—	28	6	2	137	2	141	25	Middlesbrough.
—	11	—	11	—	—	19	—	19	2	—	41	1	42	4	Darlington.
—	18	3	21	—	—	20	—	20	1	—	73	10	83	6	Stockton-on-Tees.
—	12	—	12	4	—	9	1	10	3	—	31	1	32	11	West Hartlepool.
—	121	16	137	15	—	106	11	117	19	—	299	47	346	55	Sunderland.
—	24	2	26	5	—	17	—	17	3	—	56	2	58	10	Jarrow.
—	36	—	36	7	—	50	—	50	9	—	176	1	177	43	South Shields.
—	23	—	23	4	—	24	—	24	4	—	78	7	85	15	Gateshead.
—	45	—	45	13	—	41	5	46	6	1	131	—	132	23	Newcastle-on-Tyne.
—	16	—	16	3	—	12	—	12	1	—	37	—	37	4	Tynemouth.
—	8	—	8	1	—	2	—	2	—	—	20	—	20	2	Carlisle.
—	31	2	33	5	—	14	1	15	1	—	73	9	82	12	Newport (Mon.).
—	46	3	49	12	—	32	4	36	5	—	98	8	106	19	Cardiff.
—	150	11	161	17	—	119	5	124	21	—	362	27	389	55	Rhondda.
—	67	1	68	5	—	47	—	47	5	—	217	2	219	22	Merthyr Tydfil.
—	31	1	32	3	—	22	—	22	2	—	90	2	92	8	Swansea.
10	5,727	139	5,876	829	35	7,213	122	7,370	1,265	96	19,036	461	19,593	3,251	Totals, 93 Districts.

No. 12A.

Table showing, Week by Week, during the Year 1899, for each of the **Sanitary Areas** within
Notified Cases of and **Registered Deaths** from the following **Diseases**, together with
[The Cases are copied from the Weekly Returns of Notifiable Diseases received by the Board from the Metropolit

	Sanitary Areas	Population (1891).	SMALL-POX.													
			Weekly Statement, 1st Quarter, 1899.													
			Jan. 7.		Jan. 14.		Jan. 21.		Jan. 28.		Feb. 4.		Feb. 11.		Feb. 18.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
	London (*Administrative County.*)	4,232,118	1	—	1	—	—	—	—	—	—	—	—	—	—	—
W. District.	Kensington	166,308	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Fulham	91,639	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Hammersmith	97,239	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Paddington	117,846	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Chelsea	96,253	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Hanover Sq.*	78,599	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Westminster	55,539	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. James, Westminster	24,995	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,404	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Hampstead	68,416	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Pancras	234,379	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Islington	319,143	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Mary, Stoke Newington	30,936	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Hackney	198,606	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Martin-in-the-Fields	14,616	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Strand†	25,217	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Holborn‡	34,043	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Clerkenwell	66,216	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Luke, Middlesex	42,440	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	London, City of§	37,583	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Shoreditch	124,009	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Bethnal Green	129,132	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Whitechapel‖	74,420	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. George-in-the-East	45,795	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Limehouse	57,376	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Mile End Old Town	107,592	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Poplar	166,748	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. Saviour, Southwark	27,177	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Southwark	59,712	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Newington	115,804	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Olave, Southwark	12,723	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Bermondsey	84,682	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Rotherhithe	39,255	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Lambeth	275,203	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Battersea	150,558	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Wandsworth	156,942	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Camberwell	235,344	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Greenwich	165,413	—	—	1	—	—	—	—	—	—	—	—	—	—	—
	Lewisham	92,647	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Woolwich	40,848	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Plumstead	52,436	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Lee	36,103	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Port of London	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—

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* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

No 12A.

the ADMINISTRATIVE COUNTY of LONDON and for the COUNTY as a WHOLE, the NUMBER of QUARTERLY and ANNUAL SUMMARIES of these Data for each of the AREAS in question.

Asylums Board. The Deaths are extracted from the Weekly Returns compiled by the Registrar-General.]

SMALL-POX—*continued.*														
Weekly Statement, 1st Quarter, 1899—*continued.*												Totals for 1st Quarter, 1899.		Sanitary Areas.
Feb. 25.		Mar. 4.		Mar. 11.		Mar. 18.		Mar. 25.		Apr. 1.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
—	—	2	—	—	—	—	—	—	—	—	—	4	—	London. (*Administrative County.*)
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Kensington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Fulham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hammersmith.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Paddington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Chelsea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. James, Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hampstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Pancras.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Islington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St.Mary,Stoke Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hackney.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Strand.†
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Holborn.‡
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	London, City of.§
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Shoreditch.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Bethnal Green.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Whitechapel.‖
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George-in-the-East.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Limehouse.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Mile End Old Town.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Poplar.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Bermondsey.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Rotherhithe.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lambeth.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Battersea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Wandsworth.
—	—	1	—	—	—	—	—	—	—	—	—	1	—	Camberwell.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	Greenwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lewisham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Woolwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lee.
—	—	1	—	—	—	—	—	—	—	—	—	2	—	Port of London.

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§ Including Inner Temple (population, 96).

‖ Including Tower of London (population, 868).

	Sanitary Areas.	Population (1891).	SMALL-POX—*continued.* Weekly Statement, 2nd Quarter, 1899. April 8.		April 15.		April 22.		April 29.		May 6.		May 13.		May 20.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
	London (*Administrative County.*)	4,232,118	1	—	3	—	—	—	2	—	1	—	—	—	1	—
W. District.	Kensington	166,308	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Fulham	91,639	—	—	—	—	—	—	—	—	—	—	—	—	1	—
	Hammersmith	97,239	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Paddington	117,846	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Chelsea	96,253	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Hanover Sq.*	78,599	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Westminster	55,539	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. James, Westminster	24,995	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,404	—	—	1	—	—	—	—	—	—	—	—	—	—	—
	Hampstead	68,416	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Pancras	234,379	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Islington	319,143	—	—	—	—	—	—	2	—	—	—	—	—	—	—
	St. Mary, Stoke Newington	30,936	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Hackney	198,606	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Martin-in-the-Fields	14,616	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Strand†	25,217	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Holborn‡	34,043	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Clerkenwell	66,216	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Luke, Middlesex	42,440	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	London, City of§	37,583	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Shoreditch	124,009	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Bethnal Green	129,132	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Whitechapel‖	74,420	—	—	1	—	—	—	—	—	—	—	—	—	—	—
	St. George-in-the-East	45,795	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Limehouse	57,376	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Mile End Old Town	107,592	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Poplar	166,748	—	—	1	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. Saviour, Southwark	27,177	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Southwark	59,712	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Newington	115,804	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Olave, Southwark	12,723	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Bermondsey	84,682	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Rotherhithe	39,255	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Lambeth	275,203	—	—	—	—	—	—	—	—	1	—	—	—	—	—
	Battersea	150,558	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Wandsworth	156,942	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Camberwell	235,344	1	—	—	—	—	—	—	—	—	—	—	—	—	—
	Greenwich	165,413	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Lewisham	92,647	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Woolwich	40,848	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Plumstead	52,436	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Lee	36,103	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

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* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

SMALL-POX—*continued.*

Weekly Statement 2nd Quarter, 1899—*continued.*												Totals for 2nd Quarter, 1899.		Sanitary Areas.
May 27.		June 3.		June 10.		June 17.		June 24.		July 1.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
—	—	1	—	—	1	1	—	—	—	1	—	11	1	London.
														(*Administrative County.*)
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Kensington.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	Fulham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hammersmith.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Paddington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Chelsea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. James, Westminster.
—	—	1	—	—	1	—	—	—	—	—	—	2	1	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hampstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Pancras.
—	—	—	—	—	—	1	—	—	—	—	—	3	—	Islington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Mary, Stoke Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hackney.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Strand.†
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Holborn.‡
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	London, City of.§
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Shoreditch.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Bethnal Green.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	Whitechapel.‖
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George-in-the-East.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Limehouse.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Mile End Old Town.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	Poplar.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Bermondsey.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Rotherhithe.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	Lambeth.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Battersea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Wandsworth.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	Camberwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Greenwich.
—	—	—	—	—	—	—	—	—	—	1	—	1	—	Lewisham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Woolwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

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§ Including Inner Temple (population, 96).

‖ Including Tower of London (population, 868).

	Sanitary Areas.	Population (1891).	SMALL-POX—*continued.*													
			Weekly Statement, 3rd Quarter, 1899.													
			July 8.		July 15.		July 22.		July 29.		Aug. 5.		Aug. 12.		Aug. 19.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
	London .. .. *(Administrative County.)*	4,232,118	1	—	—	1	1	—	—	—	—	—	3	—	—	—
W. District.	Kensington	166,308	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Fulham	91,639	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Hammersmith	97,239	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Paddington	117,846	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Chelsea	96,253	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Hanover Sq. *	78,599	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Westminster	55,539	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. James, Westminster ..	24,995	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,404	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Hampstead	68,416	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Pancras	234,379	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Islington	319,143	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Mary, Stoke Newington	30,936	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Hackney	198,606	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Martin-in-the-Fields ..	14,616	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Strand †	25,217	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Holborn ‡	34,043	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Clerkenwell	66,216	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Luke, Middlesex ..	42,440	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	London, City of §	37,583	—	—	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Shoreditch	124,009	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Bethnal Green	129,132	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Whitechapel ‖	74,420	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. George-in-the-East ..	45,795	1	—	—	—	—	—	—	—	—	—	—	—	—	—
	Limehouse	57,376	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Mile End Old Town ..	107,592	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Poplar	166,748	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. Saviour, Southwark ..	27,177	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Southwark ..	59,712	—	—	—	—	1	—	—	—	—	—	—	—	—	—
	Newington	115,804	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Olave, Southwark ..	12,723	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Bermondsey	84,682	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Rotherhithe	39,255	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Lambeth	275,203	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Battersea	150,558	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Wandsworth..	156,942	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Camberwell	235,344	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Greenwich	165,413	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Lewisham	92,647	—	—	—	1	—	—	—	—	—	—	—	—	—	—
	Woolwich	40,848	—	—	—	—	—	—	—	—	—	—	1	—	—	—
	Plumstead	52,436	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Lee	36,103	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Port of London	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—

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* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

Simple Continued Fever—*continued.*														
Weekly Statement, 3rd Quarter, 1899—*continued.*												Totals for 3rd Quarter, 1899.		Sanitary Areas.
Aug. 26.		Sept. 2.		Sept. 9.		Sept. 16.		Sept. 23.		Sept. 30.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
3	—	—	—	2	—	—	—	1	—	4	—	22	—	London. (*Administrative County.*)
1	—	—	—	—	—	—	—	—	—	—	—	8	—	Kensington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Fulham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hammersmith.
—	—	—	—	—	—	—	—	—	—	1	—	1	—	Paddington.
1	—	—	—	1	—	—	—	—	—	—	—	2	—	Chelsea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. James, Westminster.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Hampstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Pancras.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Islington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Mary, Stoke Newington.
—	—	—	—	—	—	—	—	—	—	—	—	2	—	Hackney.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Strand.†
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Holborn.‡
—	—	—	—	—	—	—	—	—	—	—	—	1	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	London, City of.§
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Shoreditch.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Bethnal Green.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Whitechapel.‖
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. George-in-the-East.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Limehouse.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Mile End Old Town.
—	—	—	—	1	—	—	—	—	—	—	—	1	—	Poplar.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	1	—	—	—	1	—	St. George, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Newington.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Bermondsey.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Rotherhithe.
1	—	—	—	—	—	—	—	—	—	2	—	4	—	Lambeth.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Battersea.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Wandsworth.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Camberwell.
—	—	—	—	—	—	—	—	—	—	1	—	1	—	Greenwich.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lewisham.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Woolwich.
—	—	—	—	—	—	—	—	—	—	—	—	1	—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	Port of London.

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§ Including Inner Temple (population, 96).

‖ Including Tower of London (population, 868).

	Sanitary Areas.	Population (1891).	SIMPLE CONTINUED FEVER—*continued.*													
			Weekly Statement, 4th Quarter, 1899.													
			Oct. 7.		Oct. 14.		Oct. 21.		Oct. 28.		Nov. 4.		Nov. 11.		Nov. 18.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
	London (*Administrative County.*)	4,232,118	1	—	3	—	—	—	6	—	2	—	1	—	3	—
W. District.	Kensington	166,308	1	—	—	—	—	—	1	—	1	—	—	—	1	—
	Fulham	91,639	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Hammersmith	97,239	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Paddington	117,846	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Chelsea	96,253	—	—	—	—	—	—	1	—	—	—	—	—	—	—
	St. George, Hanover Sq.*	78,599	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Westminster	55,539	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. James, Westminster	24,995	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,404	—	—	—	—	—	—	—	—	—	—	—	—	1	—
	Hampstead	68,416	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Pancras	234,379	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Islington	319,143	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Mary, Stoke Newington	30,936	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Hackney	198,606	—	—	—	—	—	—	1	—	—	—	—	—	—	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Martin-in-the-Fields	14,616	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Strand†	25,217	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Holborn‡	34,043	—	—	—	—	—	—	2	—	—	—	—	—	—	—
	Clerkenwell	66,216	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Luke, Middlesex	42,440	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	London, City of§	37,583	—	—	1	—	—	—	—	—	—	—	—	—	—	—
E. District.	Shoreditch	124,009	—	—	1	—	—	—	—	—	—	—	—	—	—	—
	Bethnal Green	129,132	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Whitechapel‖	74,420	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. George-in-the-East	45,795	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Limehouse	57,376	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Mile End Old Town	107,592	—	—	—	—	—	—	—	—	1	—	—	—	—	—
	Poplar	166,748	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. Saviour, Southwark	27,177	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Southwark	59,712	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Newington	115,804	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	St. Olave, Southwark	12,723	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Bermondsey	84,682	—	—	—	—	—	—	1	—	—	—	—	—	—	—
	Rotherhithe	39,255	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Lambeth	275,203	—	—	—	—	—	—	—	—	—	—	—	—	1	—
	Battersea	150,558	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Wandsworth	156,942	—	—	—	—	—	—	—	—	—	—	1	—	—	—
	Camberwell	235,344	—	—	1	—	—	—	—	—	—	—	—	—	—	—
	Greenwich	165,413	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Lewisham	92,647	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Woolwich	40,848	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Plumstead	52,436	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Lee	36,103	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

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* Including St. Peter's, Westminster (population, 236). † Including Middle Temple (population, 96).

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

SCARLET FEVER—*continued.*

Weekly Statement, 4th Quarter, 1899—*continued.* Nov. 25.		Dec. 2.		Dec. 9.		Dec. 16.		Dec. 23.		Dec. 30.		Totals for 4th Quarter, 1899.		Grand Totals for Year, 1899.		Sanitary Areas.
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
373	13	386	8	332	15	266	9	265	11	212	12	5,384	131	18,113	398	London. (*Administrative County.*)
12	—	11	1	5	1	7	—	5	—	6	—	133	4	444	10	Kensington.
28	—	12	1	14	4	10	—	14	1	10	—	239	10	849	33	Fulham.
8	—	9	1	10	—	5	1	5	—	8	—	102	4	441	13	Hammersmith.
8	—	12	1	9	—	4	—	11	—	6	1	114	2	384	5	Paddington.
1	1	8	—	7	1	7	—	3	—	3	—	81	2	282	8	Chelsea.
8	—	5	—	4	—	5	1	5	1	1	—	64	3	198	7	St. George, Hanover Sq.*
6	—	1	—	1	—	2	—	2	—	—	—	46	—	199	5	Westminster.
3	—	—	—	—	—	1	1	—	—	—	—	7	1	49	1	St. James, Westminster.
6	1	8	—	9	1	4	1	5	1	4	1	123	6	400	15	St. Marylebone.
9	—	13	—	3	1	5	—	4	—	3	—	130	4	289	6	Hampstead.
12	—	7	—	8	—	7	—	10	—	9	1	171	4	862	25	St. Pancras.
22	3	38	1	27	—	10	1	25	—	14	2	460	16	1,500	34	Islington.
2	—	4	—	2	—	3	—	2	—	2	1	68	1	182	3	St.Mary, Stoke Newington.
9	1	16	—	18	1	14	—	12	—	11	2	296	6	968	16	Hackney.
1	—	5	—	1	—	2	—	1	—	—	—	18	—	76	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	—	3	—	31	—	St. Martin-in-the-Fields.
1	—	—	—	—	—	2	—	1	—	5	—	17	—	55	1	Strand. †
1	—	2	—	4	—	1	—	—	—	7	—	38	1	117	3	Holborn. ‡
8	2	6	1	5	—	—	1	—	—	3	—	78	6	322	13	Clerkenwell.
—	1	2	—	1	—	3	—	2	1	2	—	36	5	162	8	St. Luke, Middlesex
—	—	1	—	—	—	1	—	2	—	4	—	15	—	74	1	London, City of. §
4	—	7	—	9	1	3	2	1	1	—	—	106	6	365	13	Shoreditch.
12	—	13	—	3	—	5	—	6	—	6	—	106	1	431	9	Bethnal Green.
5	—	2	—	5	—	7	—	6	—	2	—	68	1	210	2	Whitechapel. ‖
1	—	2	—	—	—	—	—	2	—	2	—	27	—	99	3	St. George-in-the-East.
11	—	7	—	3	—	3	—	—	—	7	—	77	—	171	1	Limehouse.
14	1	3	—	8	1	2	—	3	—	4	—	94	2	296	5	Mile End Old Town.
5	—	11	—	10	—	2	—	8	1	12	—	149	3	422	10	Poplar.
2	—	—	—	3	—	1	—	1	—	—	—	17	1	91	2	St. Saviour, Southwark.
4	—	9	—	2	—	6	—	1	1	3	—	69	4	238	6	St. George, Southwark.
10	—	11	—	14	—	4	—	6	1	3	2	169	6	509	13	Newington.
2	—	—	—	1	—	—	—	1	1	—	—	15	1	64	2	St. Olave, Southwark.
4	—	7	—	5	—	5	—	8	—	1	—	106	2	402	10	Bermondsey.
5	1	5	—	4	—	1	1	1	—	1	—	44	3	256	11	Rotherhithe.
15	—	25	—	26	1	23	—	19	—	15	1	381	5	1,016	25	Lambeth.
19	—	16	1	8	1	17	—	9	—	4	1	236	6	723	14	Battersea.
12	—	17	—	11	—	21	—	13	1	9	—	257	2	912	9	Wandsworth.
30	—	26	1	22	—	20	—	13	1	17	—	325	6	1,146	19	Camberwell.
29	2	21	—	24	—	19	—	11	—	19	—	367	3	1,206	17	Greenwich.
28	—	25	—	23	2	11	—	26	—	2	—	289	3	580	6	Lewisham.
4	—	—	—	4	—	—	—	3	—	1	—	28	—	167	4	Woolwich.
11	—	14	—	17	—	8	—	5	—	4	—	160	1	708	6	Plumstead.
1	—	6	—	3	—	4	—	3	—	2	—	57	—	195	4	Lee.
—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	Port of London.

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§ Including Inner Temple (population, 96).

‖ Including Tower of London (population, 868).

	Sanitary Areas.	Population (1891).	Typhus Fever.											
			Weekly Statement, 1899.											
			Jan. 28.	Feb. 4.		Feb. 25.		Mar. 11.	April 1.	Totals for 1st Quarter, 1899.		May 27.	Totals for 2nd Quarter, 1899.	
			Cases.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Cases.	Cases.	Deaths.	Cases.	Cases.	Deaths.
	London .. .. (*Administrative County.*)	4,232,118	1	1	1	2	1	2	1	7	2	1	1	—
W. District.	Kensington	166,308	—	—	—	—	—	—	—	—	—	1	1	—
	Fulham	91,639	—	—	—	—	—	—	—	—	—	—	—	—
	Hammersmith	97,239	—	—	—	—	—	—	—	—	—	—	—	—
	Paddington	117,846	—	—	—	—	—	—	—	—	—	—	—	—
	Chelsea	96,253	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Hanover Sq.* ..	78,599	—	—	—	—	—	—	—	—	—	—	—	—
	Westminster	55,539	—	—	—	—	—	—	—	—	—	—	—	—
	St. James, Westminster ..	24,995	—	—	—	—	—	—	—	—	—	—	—	—
N. District.	St. Marylebone	142,404	—	—	—	—	—	—	—	—	—	—	—	—
	Hampstead	68,416	—	—	—	—	—	—	—	—	—	—	—	—
	St. Pancras	234,379	—	—	—	—	—	—	—	—	—	—	—	—
	Islington	319,143	—	—	—	—	—	—	—	—	—	—	—	—
	St. Mary, Stoke Newington ..	30,936	—	—	—	—	—	—	—	—	—	—	—	—
	Hackney	198,606	—	—	—	—	—	—	—	—	—	—	—	—
Central District.	St. Giles and St. George, Bloomsbury.	39,782	—	—	—	—	—	—	—	—	—	—	—	—
	St. Martin-in-the-Fields ..	14,616	—	—	—	—	—	—	—	—	—	—	—	—
	Strand †	25,217	—	—	—	—	—	—	—	—	—	—	—	—
	Holborn ‡	34,043	—	—	—	—	—	—	—	—	—	—	—	—
	Clerkenwell	66,216	—	—	—	—	—	—	—	—	—	—	—	—
	St. Luke, Middlesex	42,440	—	—	—	—	—	—	—	—	—	—	—	—
	London, City of §	37,583	—	—	—	—	—	—	—	—	—	—	—	—
E. District.	Shoreditch	124,009	—	—	—	—	—	—	—	—	—	—	—	—
	Bethnal Green	129,132	—	—	—	—	—	—	—	—	—	—	—	—
	Whitechapel ‖	74,420	—	—	—	—	—	—	—	—	—	—	—	—
	St. George-in-the-East ..	45,795	—	—	—	—	—	—	—	—	—	—	—	—
	Limehouse	57,376	—	—	—	—	—	—	—	—	—	—	—	—
	Mile End Old Town	107,592	—	—	—	—	—	—	—	—	—	—	—	—
	Poplar	166,748	—	—	—	—	—	—	—	—	—	—	—	—
S. District.	St. Saviour, Southwark ..	27,177	—	—	—	—	—	—	—	—	—	—	—	—
	St. George, Southwark ..	59,712	—	—	—	1	—	—	—	1	—	—	—	—
	Newington	115,804	—	—	—	—	—	—	—	—	—	—	—	—
	St. Olave, Southwark	12,723	—	—	—	—	—	—	—	—	—	—	—	—
	Bermondsey	84,682	—	—	—	—	1	2	1	3	1	—	—	—
	Rotherhithe	39,255	—	1	1	—	—	—	—	1	1	—	—	—
	Lambeth	275,203	—	—	—	1	—	—	—	1	—	—	—	—
	Battersea	150,558	—	—	—	—	—	—	—	—	—	—	—	—
	Wandsworth	156,942	—	—	—	—	—	—	—	—	—	—	—	—
	Camberwell	235,344	1	—	—	—	—	—	—	1	—	—	—	—
	Greenwich	165,413	—	—	—	—	—	—	—	—	—	—	—	—
	Lewisham	92,647	—	—	—	—	—	—	—	—	—	—	—	—
	Woolwich	40,848	—	—	—	—	—	—	—	—	—	—	—	—
	Plumstead	52,436	—	—	—	—	—	—	—	—	—	—	—	—
	Lee	36,103	—	—	—	—	—	—	—	—	—	—	—	—
	Port of London	—	—	—	—	—	—	—	—	—	—	—	—	—

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* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

TYPHUS FEVER—*continued.*

Weekly Statement, 1899—*continued.*

July 22.	Sept. 2.	Totals for 3rd Quarter, 1899.		Oct. 21.	Nov. 4.	Dec. 9.	Totals for 4th Quarter, 1899.		Grand Totals for Year, 1899.		Sanitary Areas.
Cases.	Cases.	Cases.	Deaths.	Cases.	Cases.	Cases.	Cases.	Deaths.	Cases.	Deaths.	
1	1	2	—	1	1	2	4	—	14	2	London.
											(*Administrative County.*)
—	—	—	—	—	—	—	—	—	1	—	Kensington.
—	—	—	—	—	—	—	—	—	—	—	Fulham.
—	1	1	—	—	—	—	—	—	1	—	Hammersmith.
1	—	1	—	—	—	—	—	—	1	—	Paddington.
—	—	—	—	—	—	—	—	—	—	—	Chelsea.
—	—	—	—	—	—	—	—	—	—	—	St. George, Hanover Sq.*
—	—	—	—	—	—	—	—	—	—	—	Westminster.
—	—	—	—	—	—	—	—	—	—	—	St. James, Westminster.
—	—	—	—	—	—	—	—	—	—	—	St. Marylebone.
—	—	—	—	—	—	—	—	—	—	—	Hampstead.
—	—	—	—	—	—	—	—	—	—	—	St. Pancras.
—	—	—	—	—	—	—	—	—	—	—	Islington.
—	—	—	—	—	—	—	—	—	—	—	St. Mary, Stoke Newington.
—	—	—	—	—	—	—	—	—	—	—	Hackney.
—	—	—	—	—	—	—	—	—	—	—	St. Giles and St. George, Bloomsbury.
—	—	—	—	—	—	—	—	—	—	—	St. Martin-in-the-Fields.
—	—	—	—	—	—	—	—	—	—	—	Strand.†
—	—	—	—	—	—	—	—	—	—	—	Holborn.‡
—	—	—	—	—	—	—	—	—	—	—	Clerkenwell.
—	—	—	—	—	—	—	—	—	—	—	St. Luke, Middlesex.
—	—	—	—	—	—	—	—	—	—	—	London, City of.§
—	—	—	—	—	—	—	—	—	—	—	Shoreditch.
—	—	—	—	—	—	—	—	—	—	—	Bethnal Green.
—	—	—	—	1	1	2	4	—	4	—	Whitechapel.‖
—	—	—	—	—	—	—	—	—	—	—	St. George-in-the-East.
—	—	—	—	—	—	—	—	—	—	—	Limehouse.
—	—	—	—	—	—	—	—	—	—	—	Mile End Old Town.
—	—	—	—	—	—	—	—	—	—	—	Poplar.
—	—	—	—	—	—	—	—	—	—	—	St. Saviour, Southwark.
—	—	—	—	—	—	—	—	—	1	—	St. George, Southwark.
—	—	—	—	—	—	—	—	—	—	—	Newington.
—	—	—	—	—	—	—	—	—	—	—	St. Olave, Southwark.
—	—	—	—	—	—	—	—	—	3	1	Bermondsey.
—	—	—	—	—	—	—	—	—	1	1	Rotherhithe.
—	—	—	—	—	—	—	—	—	1	—	Lambeth.
—	—	—	—	—	—	—	—	—	—	—	Battersea.
—	—	—	—	—	—	—	—	—	—	—	Wandsworth.
—	—	—	—	—	—	—	—	—	1	—	Camberwell.
—	—	—	—	—	—	—	—	—	—	—	Greenwich.
—	—	—	—	—	—	—	—	—	—	—	Lewisham.
—	—	—	—	—	—	—	—	—	—	—	Woolwich.
—	—	—	—	—	—	—	—	—	—	—	Plumstead.
—	—	—	—	—	—	—	—	—	—	—	Lee.
—	—	—	—	—	—	—	—	—	—	—	Port of London.

§ Including Inner Temple (population, 96).

‖ Including Tower of London (population, 868).

App. A, No. 13.

Compilation of Returns of Notified Infectious Diseases, and registered Deaths therefrom, 1893-97.

No. 13.

TABLE showing Quarterly during the Five-Year period 1893-97, CASES and of REGISTERED DEATHS from the under-mentioned each of the URBAN SANITARY DISTRICTS in question.

[The Cases are a Summary of the Weekly Returns of Notifiable Diseases received Quarterly Returns of

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	SMALL-POX.									
			1st Quarters, 1893-97.		2nd Quarters. 1893-97.		3rd Quarters. 1893-97.		4th Quarters. 1893-97.		Total for Quinquenniad, 1893-97.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
I.	London .. .. (*Administrative Co.*)	4,232,118	1,026	76	2,170	142	1,602	126	530	35	5,327	379
II. South-Eastern.	Croydon	102,695	4	1	19	..	9	..	2	..	34	1
	Dover	33,300	2	..	..	..	..	..	..	..	2	..
	Eastbourne	34,969	..	..	..	..	13	2	5	..	18	2
	Bournemouth	37,781	..	..	2	..	6	1	..	..	8	1
	Southampton	65,325	89	6	49	5	19	3	7	..	164	14
	Reading	60,054	4	..	38	..	2	..	..	..	44	..
III. South Midland.	Willesden	61,265	11	1	9	..	12	2	17	..	49	3
	Hornsey	44,205	9	..	5	..	4	..	4	..	22	..
	Tottenham	71,343	5	1	19	..	46	2	1	..	71	3
	Oxford	45,742	25	..	4	..	..	..	4	..	33	..
	Northampton	61,012	21	..	15	..	..	..	..	..	36	..
	Cambridge	36,983	2	..	6	..	..	..	1	..	9	..
IV. Eastern.	Leyton	63,056	35	..	38	..	12	..	2	1	87	1
	Walthamstow	46,346	9	..	10	..	1	..	..	..	20	..
	West Ham	204,903	319	27	450	42	167	27	193	22	1,129	118
	Colchester	34,559	..	..	..	..	..	..	..	..	..	..
	Norwich	100,970	1	..	1	..	..	..	..	..	2	..
V. South-Western.	Exeter	37,404	8	1	29	1	..	..	3	..	40	2
	Plymouth	84,248	..	..	7	1	19	4	2	..	28	5
	Devonport	54,803	4	..	7	..	13	..	2	..	26	..
	Bath	51,844	2	..	..	..	..	..	11	3	13	3
VI. West Midland.	Bristol	258,296	260	23	65	7	44	3	170	18	539	51
	Gloucester	39,444	711	144	1,272	277	29	6	22	3	2,034	430
	Burton-on-Trent ..	46,047	12	..	9	1	2	..	..	..	23	1
	Wolverhampton ..	82,662	7	..	30	3	26	2	23	1	86	6
	Walsall	71,789	138	9	30	..	194	14	582	54	944	77
	West Bromwich ..	59,474	14	..	21	..	7	..	33	7	75	7
	Worcester..	42,908	24	..	51	2	3	..	5	1	83	3
	Smethwick	36,170	17	..	90	5	12	..	45	4	164	9
	Birmingham	478,113	864	73	917	73	425	29	998	74	3,204	249
	Aston Manor	68,639	136	10	74	7	32	1	127	2	369	20
	Coventry	52,724	11	..	32	1	4	..	1	..	48	1
VII. North Midland.	Leicester	174,624	109	4	121	5	46	2	22	4	298	15
	Grimsby	51,934	2	1	..	..	..	..	2	..	4	1
	Nottingham	213,877	90	5	26	1	..	..	7	1	123	7
	Derby	94,146	48	8	77	6	15	..	7	1	147	15

No. 13.

for each of 76 URBAN SANITARY DISTRICTS, the Number of NOTIFIED DISEASES, together with a QUINQUENNIAL SUMMARY of these data for

by the Board from Medical Officers of Health. The Deaths are extracted from the the Registrar-General.]

APP. A, No. 13.

Compilation of Returns of Notified Infectious Diseases, and registered Deaths therefrom, 1893-97.

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	SMALL-POX—*continued.*									
			1st Quarters, 1893-97.		2nd Quarters, 1893-97.		3rd Quarters, 1893-97.		4th Quarters, 1893-97.		Total for Quinquenniad, 1893-97.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
VIII. North-Western.	Stockport	70,263	23	2	24	1	17	..	2	..	66	3
	Macclesfield	36,000	6	..	4	..	..	..	..	..	10	..
	Birkenhead	99,857	7	..	10	1	5	..	8	1	30	2
	Liverpool	629,443	139	15	78	5	66	5	151	17	434	42
	St. Helens (Lancs.) ..	71,288	33	5	15	..	1	..	..	..	49	5
	Southport..	41,406	..	..	6	..	6	..	4	..	16	..
	Wigan	55,013	38	3	24	2	40	2	36	5	138	12
	Warrington	52,743	112	11	73	5	5	1	..	..	190	17
	Bolton	115,002	16	4	27	2	2	1	9	1	54	8
	Bury (Lancs.)	57,212	8	..	28	5	3	1	2	..	41	6
	Salford	198,139	88	7	96	12	43	5	..	..	227	24
	Manchester	505,368	409	29	427	33	114	10	16	1	966	73
	Ashton-under-Lyne ..	40,463	1	..	11	..	12	..	1	..	25	..
	Oldham	131,463	308	40	231	35	151	27	54	8	744	110
	Accrington	38,603	1	..	5	..	1	..	..	..	7	..
	Burnley	87,016	31	2	46	4	14	..	7	..	98	6
	Blackburn	120,064	37	..	35	2	14	2	..	..	86	4
	Darwen	34,192	2	..	8	..	1	..	..	..	11	..
	Preston	107,573	3	..	23	1	11	1	..	..	37	2
	Barrow-in-Furness ..	51,712	1	..	6	1	..	..	..	..	7	1
IX. Yorkshire.	Huddersfield	95,420	23	..	18	..	10	..	2	..	53	..
	Halifax	89,832	102	15	224	22	17	1	7	1	350	39
	Bradford	216,361	175	26	276	23	293	32	453	62	1,197	143
	Barnsley	35,427	24	4	8	2	3	..	..	..	35	6
	Sheffield	324,243	40	1	56	4	17	..	..	..	113	5
	Rotherham	42,061	43	2	11	1	..	..	7	..	61	3
	York	67,004	35	4	31	2	4	..	..	..	70	6
	Hull	200,044	74	3	120	6	26	1	13	2	233	12
	Middlesbrough	75,532	32	2	45	6	23	3	28	..	128	11
X. Northern.	Darlington	38,060	1	..	1	..	..	..	1	..	3	..
	Sunderland	131,015	15	3	27	1	3	1	5	..	50	5
	South Shields	78,391	32	2	61	4	3	..	4	..	100	6
	Newcastle-on-Tyne ..	186,300	6	..	13	..	8	..	1	..	28	..
	Tynemouth	46,588	5	..	3	..	26	2	4	..	38	2
	Carlisle	39,176	9	1	5	..	1	..	..	..	15	1
XI. Welsh.	Newport (Mon.) ..	54,707	19	3	1	..	1	..	7	..	28	3
	Cardiff	128,915	58	3	10	1	..	..	3	..	71	4
	Merthyr Tydfil	58,080	12	1	..	..	..	..	2	..	14	1
	Swansea	90,349	58	2	34	..	2	..	2	..	96	2
	Totals, 76 Districts ..	11,876,097	6,034	580	7,814	760	3,707	319	3,657	329	21,212	1,988

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	SCARLET FEVER.									
			1st Quarters, 1893–97.		2nd Quarters, 1893–97.		3rd Quarters, 1893–97.		4th Quarters, 1893–97.		Total for Quinquennial, 1893–97.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
I.	London .. .. .. (*Administrative Co.*)	4,232,118	21,766	1,182	25,493	1,135	38,481	1,373	37,930	1,422	123,670	5,112
II. South-Eastern.	Croydon	102,695	424	16	403	10	496	5	600	9	1,923	40
	Dover	33,300	56	4	33	..	34	1	65	..	188	5
	Eastbourne	34,969	115	2	116	2	138	3	118	2	487	9
	Bournemouth	37,781	121	5	157	7	206	8	210	6	694	26
	Southampton	65,325	294	7	333	16	463	11	577	22	1,667	56
	Reading	60,054	225	7	215	6	237	..	275	9	952	22
III. South Midland.	Willesden	61,265	492	17	494	14	568	18	684	17	2,238	66
	Hornsey	44,205	521	4	387	10	427	8	438	10	1,773	32
	Tottenham	71,343	478	16	518	8	593	24	750	25	2,339	73
	Oxford	45,742	220	10	241	5	216	3	269	6	946	24
	Northampton	61,012	347	15	366	13	690	18	737	30	2,140	76
	Cambridge	36,983	82	1	94	1	122	1	151	7	449	10
IV. Eastern.	Leyton	63,056	581	11	461	23	736	19	943	20	2,721	73
	Walthamstow	46,346	350	8	406	11	509	11	641	12	1,906	42
	West Ham	204,903	1,601	62	1,527	53	2,096	72	2,221	59	7,445	246
	Colchester	34,559	187	7	178	4	233	6	203	5	801	22
	Norwich	100,970	465	13	410	15	701	17	1,008	15	2,584	60
V. South-Western.	Exeter	37,404	266	6	204	3	267	5	411	10	1,148	24
	Plymouth	84,248	283	17	171	6	175	4	287	13	916	40
	Devonport	54,803	144	9	107	9	133	4	157	5	541	27
	Bath	51,844	205	6	206	9	153	6	250	8	814	29
VI. West Midland.	Bristol	258,298	1,234	51	1,058	38	1,144	36	1,559	47	4,995	172
	Gloucester	39,444	154	1	193	3	266	8	274	12	887	24
	Burton-on-Trent ..	46,047	361	9	277	6	349	3	564	22	1,551	40
	Wolverhampton ..	82,662	604	32	620	29	864	50	1,181	43	3,269	154
	Walsall	71,789	335	7	497	24	552	18	586	21	1,970	70
	West Bromwich ..	59,474	283	30	232	12	279	19	378	25	1,175	86
	Worcester	42,908	189	2	161	9	302	5	338	2	990	18
	Smethwick	36,170	274	1	178	3	222	7	354	7	1,028	18
	Birmingham	478,113	2,193	96	2,522	114	3,473	115	3,541	187	11,729	512
	Aston Manor	68,639	316	16	308	6	514	5	602	12	1,740	39
	Coventry	52,724	198	4	240	11	470	15	485	15	1,393	45
VII. North Midland.	Leicester	174,624	1,440	38	1,682	73	2,372	70	2,392	66	7,886	247
	Grimsby	51,934	262	9	210	10	142	6	219	4	833	29
	Nottingham	213,877	1,241	70	1,038	52	1,234	46	1,566	77	5,079	245
	Derby	94,146	481	13	504	15	624	12	630	18	2,239	58

APP. A, No. 13

Compilation o
Returns of
Notified Infectious Diseases,
and registered
Deaths therefrom, 1893-97

SCARLET FEVER—*continued.*

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	1st Quarters, 1893-97.		2nd Quarters 1893-97.		3rd Quarters, 1893-97.		4th Quarters, 1893-97.		Total for Quinquenniad, 1893-97.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
VIII. North-Western.	Stockport	70,263	250	10	309	17	408	21	429	11	1,391	59
	Macclesfield	36,000	98	6	92	3	132	7	94	4	416	20
	Birkenhead	99,857	528	15	404	14	501	21	1,024	45	2,457	95
	Liverpool	629,443	3,691	238	3,136	197	4,099	241	5,420	361	16,346	1,037
	St. Helens (Lancs.)	71,288	700	27	608	36	593	27	1,134	44	3,035	134
	Southport	41,406	307	13	207	10	360	10	452	19	1,326	52
	Wigan	55,013	225	14	341	23	338	28	290	17	1,194	82
	Warrington	52,743	260	23	213	28	262	29	370	33	1,105	113
	Bolton	115,002	674	35	681	37	770	30	806	27	2,931	129
	Bury (Lancs.)	57,212	443	17	401	24	359	17	385	16	1,588	74
	Salford	198,139	1,132	105	1,175	98	1,499	106	1,511	106	5,317	415
	Manchester	505,368	2,212	194	2,268	152	3,027	186	3,267	209	10,774	741
	Ashton-under-Lyne	40,463	243	13	175	16	259	8	302	17	979	54
	Oldham	131,463	561	32	436	29	578	36	464	31	2,039	128
	Accrington	38,603	176	9	147	7	194	6	315	8	832	30
	Burnley	87,016	557	34	605	30	861	34	743	35	2,766	133
	Blackburn	120,064	208	6	254	10	274	10	297	12	1,033	38
	Darwen	34,192	123	4	145	6	196	4	192	9	656	23
	Preston	107,573	274	22	203	12	157	5	220	12	854	51
	Barrow-in-Furness	51,712	294	7	429	7	301	14	332	8	1,356	36
IX. Yorkshire.	Huddersfield	95,420	539	29	707	29	699	30	758	30	2,703	118
	Halifax	89,832	193	3	235	7	201	9	118	13	847	32
	Bradford	216,361	821	56	750	38	1,265	62	748	44	3,584	200
	Barnsley	35,427	339	22	320	34	344	19	353	30	1,356	105
	Sheffield	324,243	1,606	91	1,749	75	1,724	92	2,011	97	7,090	355
	Rotherham	42,061	237	9	196	14	262	16	345	21	1,040	60
	York	67,004	143	7	193	1	195	5	335	3	866	16
	Hull	200,044	1,389	54	1,220	55	1,210	43	1,729	77	5,548	229
	Middlesbrough	75,532	1,035	15	634	19	680	26	871	23	3,220	83
X. Northern.	Darlington	38,060	218	7	201	10	144	5	161	6	724	28
	Sunderland	131,015	760	26	613	27	651	20	1,091	27	3,115	100
	South Shields	78,391	635	36	561	25	663	17	943	41	2,802	119
	Newcastle-on-Tyne	186,300	903	23	698	29	826	23	1,455	46	3,882	121
	Tynemouth	46,588	266	20	213	14	250	7	240	16	969	57
	Carlisle	39,176	113	4	81	1	170	3	379	19	743	27
XI. Welsh.	Newport (Mon.)	54,707	471	19	337	3	347	6	433	10	1,588	38
	Cardiff	128,915	839	16	662	32	874	18	1,040	34	3,415	100
	Merthyr Tydfil	58,080	314	14	379	15	316	13	368	7	1,377	49
	Swansea	90,349	789	23	604	23	512	9	909	20	2,814	75
	Totals, 76 Districts	11,876,097	63,357	3,102	64,822	2,972	86,977	3,295	96,028	3,858	311,184	13,227

APP. A, No. 13.

Compilation of Returns of otified Infectious Diseases, and registered Deaths therefrom, 1893-97.

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	DIPHTHERIA.									
			1st Quarters, 1893-97.		2nd Quarters, 1893-97.		3rd Quarters, 1893-97.		4th Quarters, 1893-97.		Total for Quinquenniad, 1893-97.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
I.	London .. .. .. (*Administrative Co.*)	4,232,118	12,315	3,117	13,173	2,768	16,562	3,240	18,554	4,074	60,604	13,199
II. South-Eastern.	Croydon	102,695	194	35	207	52	248	41	260	47	909	175
	Dover	33,300	26	8	16	5	21	5	34	8	97	26
	Eastbourne	34,969	80	9	67	10	66	7	73	11	286	37
	Bournemouth	37,781	17	2	23	8	22	11	54	8	116	29
	Southampton	65,325	58	7	39	6	56	10	72	5	225	28
	Reading	60,054	21	7	22	8	26	5	23	4	92	24
III. South Midland.	Willesden	61,265	212	34	230	36	225	42	308	73	965	185
	Hornsey	44,205	111	21	101	20	143	27	172	35	527	103
	Tottenham	71,343	222	34	126	30	187	48	270	62	805	174
	Oxford	45,742	115	22	76	12	43	9	79	23	313	66
	Northampton	61,012	16	5	11	6	11	6	13	5	51	22
	Cambridge	36,983	19	1	12	3	15	2	25	6	71	12
IV. Eastern.	Leyton	63,056	266	23	344	58	350	47	349	48	1,309	176
	Walthamstow	46,346	157	22	174	40	163	30	244	56	738	148
	West Ham	204,903	762	173	822	148	896	172	1,274	272	3,754	765
	Colchester..	34,559	57	7	60	3	32	8	39	10	188	28
	Norwich	100,970	129	29	77	15	101	19	181	31	488	94
V. South-Western.	Exeter	37,404	24	3	13	4	22	7	26	12	85	26
	Plymouth..	84,248	61	12	55	14	43	6	85	17	244	49
	Devonport	54,803	34	11	35	9	26	7	40	14	135	41
	Bath	51,844	51	15	66	17	53	11	114	25	284	68
VI. West Midland.	Bristol	258,296	252	69	234	43	217	60	297	74	1,000	245
	Gloucester	39,444	75	16	76	13	97	30	124	35	372	94
	Burton-on-Trent ..	46,047	86	15	130	20	101	19	100	23	417	77
	Wolverhampton ..	82,662	234	56	269	55	262	46	327	74	1,092	231
	Walsall	71,789	28	8	30	7	26	9	36	10	120	34
	West Bromwich ..	59,474	23	6	36	20	24	10	32	13	115	49
	Worcester..	42,908	81	20	98	27	183	28	218	34	580	109
	Smethwick	36,170	15	4	33	3	16	6	65	15	129	28
	Birmingham	478,113	685	223	709	178	786	144	888	193	3,068	738
	Aston Manor	68,639	156	28	99	23	101	17	151	41	507	109
	Coventry	52,724	16	6	8	2	15	4	19	4	58	16
VII. North Midland.	Leicester	174,624	141	44	156	39	172	45	184	77	653	205
	Grimsby	51,934	155	36	117	29	66	9	132	42	470	116
	Nottingham .. .	213,877	88	26	81	11	58	15	85	25	312	77
	Derby	94,146	72	16	53	4	50	10	71	7	246	37

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	DIPHTHERIA—*continued.*									
			1st Quarters, 1893-97.		2nd Quarters, 1893-97.		3rd Quarters, 1893-97.		4th Quarters, 1893-97.		Total for Quinquenniad, 1893-97.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
VIII. North-Western.	Stockport	70,263	48	21	29	13	53	23	38	24	168	81
	Macclesfield	36,000	111	27	61	20	112	30	117	33	401	110
	Birkenhead	99,857	135	43	113	30	104	34	186	43	538	150
	Liverpool	629,443	382	146	311	104	339	130	537	183	1,569	563
	St. Helens (Lancs.) ..	71,288	97	21	68	11	65	12	101	22	331	66
	Southport	41,406	39	10	34	6	33	7	36	10	152	33
	Wigan	55,013	14	4	14	3	12	6	31	6	71	19
	Warrington	52,743	23	12	9	4	8	2	14	9	54	27
	Bolton	115,002	84	17	59	16	50	17	24	8	217	58
	Bury (Lancs.)	57,212	35	21	31	11	35	13	53	33	154	78
	Salford	198,139	245	89	179	41	204	55	215	79	843	264
	Manchester	505,368	434	166	432	133	395	95	428	153	1,689	547
	Ashton-under-Lyne ..	40,463	13	7	22	9	11	2	16	12	62	30
	Oldham	131,463	83	39	51	30	51	25	76	35	261	129
	Accrington	38,603	32	9	19	..	26	2	91	12	168	23
	Burnley	87,016	102	35	115	46	149	51	192	62	558	194
	Blackburn	120,064	20	9	23	7	21	10	34	21	98	47
	Darwen	34,192	9	7	9	5	1	..	3	3	22	15
	Preston	107,573	54	18	23	6	32	10	33	12	142	46
	Barrow-in-Furness ..	51,712	38	16	38	15	41	18	43	7	160	56
IX. Yorkshire.	Huddersfield	95,420	53	24	42	25	40	18	48	14	183	81
	Halifax	89,832	63	30	48	15	49	11	66	23	226	79
	Bradford	216,361	67	33	49	24	51	14	63	21	230	92
	Barnsley	35,427	43	11	54	9	49	9	64	9	210	38
	Sheffield	324,243	164	77	128	72	101	51	135	79	528	279
	Rotherham	42,061	17	5	18	3	25	8	20	5	80	21
	York	67,004	28	4	30	1	37	5	45	11	140	21
	Hull	200,044	151	42	166	45	157	31	173	53	647	171
	Middlesbrough	75,532	28	14	31	14	35	18	60	22	154	68
X. Northern.	Darlington	38,060	14	7	14	5	19	10	9	6	56	28
	Sunderland	131,015	39	15	28	8	23	8	31	9	121	40
	South Shields	78,391	51	18	34	11	50	10	53	12	188	51
	Newcastle-on-Tyne ..	186,300	208	49	117	23	143	36	249	71	717	179
	Tynemouth	46,588	36	12	18	5	21	5	33	5	108	27
	Carlisle	39,176	72	17	37	5	46	11	45	9	200	42
XI. Welsh.	Newport (Mon.).. ..	54,707	54	22	28	12	32	10	51	13	165	57
	Cardiff	128,915	416	95	449	96	387	76	570	108	1,822	375
	Merthyr Tydfil	58,080	120	25	119	33	63	17	106	44	408	118
	Swansea	90,349	35	8	32	10	35	14	44	16	146	48
	Totals, 76 Districts ..	11,876,097	20,711	5,395	20,950	4,670	24,590	5,116	29,151	6,810	95,402	21,991

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	"FEVER."									
			1st Quarters, 1893-97.					2nd Quarters, 1893-97.				
			Notifications.				Deaths.	Notifications.				Deaths.
			Typhus.	Enteric.	Continued.	Total.		Typhus.	Enteric.	Continued.	Total.	
I.	London .. .. (*Administrative Co.*)	4,232,118	15	3,122	124	3,261	654	20	2,840	136	2,996	503
II. South-Eastern.	Croydon	102,695	..	65	1	66	17	..	42	4	46	10
	Dover	33,300	..	16	..	16	9	..	7	2	9	5
	Eastbourne	34,969	..	17	..	17	1	..	11	..	11	3
	Bournemouth	37,781	..	6	..	6	1	..	14	1	15	6
	Southampton	65,325	..	47	1	48	11	..	79	1	80	11
	Reading	60,054	14	32	..	46	9	..	29	..	29	7
III. South Midland.	Willesden	61,265	1	56	1	58	13	..	46	1	47	4
	Hornsey	44,205	..	28	1	29	4	..	20	1	21	7
	Tottenham	71,343	..	100	2	102	17	..	87	1	88	11
	Oxford	45,742	..	17	..	17	1	..	9	..	9	2
	Northampton	61,012	..	23	..	23	7	..	25	..	25	4
	Cambridge	36,983	..	41	..	41	8	1	32	1	34	6
IV. Eastern.	Leyton	63,056	..	64	11	75	7	..	75	11	86	16
	Walthamstow	46,346	..	102	..	102	9	..	83	1	84	7
	West Ham	204,903	1	250	2	253	49	2	195	14	211	41
	Colchester	34,559	..	23	12	35	..	..	12	6	18	2
	Norwich	100,970	..	137	..	137	28	..	159	..	159	17
V. South-Western.	Exeter	37,404	..	74	3	77	10	..	63	7	70	15
	Plymouth	84,248	..	40	..	40	11	..	35	..	35	9
	Devonport	54,803	..	23	1	24	5	..	43	..	43	11
	Bath	51,844	..	22	..	22	7	..	19	..	19	2
VI. West Midland.	Bristol	258,296	1	159	4	164	39	..	132	5	137	27
	Gloucester	39,444	..	50	1	51	11	..	24	1	25	6
	Burton-on-Trent . ..	46,047	..	43	2	45	9	1	30	..	31	8
	Wolverhampton	82,662	..	120	3	123	23	..	105	5	110	17
	Walsall	71,789	..	98	3	101	18	..	59	2	61	10
	West Bromwich	59,474	..	84	1	85	13	..	69	3	72	11
	Worcester	42,908	..	61	1	62	7	..	23	3	26	3
	Smethwick	36,170	1	23	1	25	9	..	27	..	27	6
	Birmingham	478,113	..	597	6	603	114	1	460	14	475	90
	Aston Manor	68,639	..	69	..	69	12	..	49	4	53	10
	Coventry	52,724	..	43	6	49	8	..	29	1	30	4
VII. North Midland.	Leicester	174,624	..	248	..	248	37	..	187	..	187	31
	Grimsby	51,934	..	92	21	113	19	..	86	10	96	14
	Nottingham	213,877	..	550	..	550	93	..	254	..	254	52
	Derby	94,146	..	116	..	116	31	..	70	..	70	10

"FEVER"—*continued.*															
3rd Quarters, 1893–97.					4th Quarters, 1893–97.					Total for Quinquenniad, 1893–97.					Urban Sanitary Districts.
Notifications.					Notifications.					Notifications.					
Typhus.	Enteric.	Continued.	Total.	Deaths.	Typhus.	Enteric.	Continued.	Total.	Deaths.	Typhus.	Enteric.	Continued.	Total.	Deaths.	
19	4,529	174	4,722	802	17	6,369	207	6,593	1,243	71	16,860	641	17,572	3,202	London. (*Administrative Co.*)
1	109	13	123	16	..	81	4	85	17	1	297	22	320	60	Croydon.
..	16	2	18	3	..	24	..	24	1	..	63	4	67	18	Dover.
..	62	..	62	4	..	54	..	54	9	..	144	..	144	17	Eastbourne.
..	14	1	15	6	..	16	1	17	4	..	50	3	53	17	Bournemouth.
..	141	1	142	22	3	120	..	123	17	3	387	3	393	61	Southampton.
..	43	..	43	8	..	37	..	37	5	14	141	..	155	29	Reading.
..	76	..	76	13	..	115	..	115	25	1	293	2	296	55	Willesden.
..	48	..	48	3	..	71	5	76	10	..	167	7	174	24	Hornsey.
1	179	3	183	24	..	218	1	219	25	1	584	7	592	77	Tottenham.
..	37	1	38	6	1	49	..	50	7	1	112	1	114	16	Oxford.
..	47	..	47	13	..	63	..	63	9	..	158	..	158	33	Northampton.
..	78	2	80	11	..	65	1	66	11	1	216	4	221	36	Cambridge.
..	169	13	182	24	1	176	16	193	14	1	484	51	536	61	Leyton.
..	159	4	163	22	..	141	7	148	24	..	485	12	497	62	Walthamstow.
1	560	9	570	90	1	576	15	592	107	5	1,581	40	1,626	287	West Ham.
..	22	8	30	6	..	41	11	52	16	..	98	37	135	24	Colchester.
..	450	3	453	43	1	382	..	383	51	1	1,128	3	1,132	139	Norwich.
1	93	7	101	14	..	79	4	83	18	1	309	21	331	57	Exeter.
..	65	..	65	10	..	59	..	59	12	..	199	..	199	42	Plymouth.
..	72	..	72	19	..	46	..	46	10	..	184	1	185	45	Devonport.
..	18	..	18	3	..	23	..	23	4	..	82	..	82	16	Bath.
..	158	5	163	24	..	389	2	391	53	1	838	16	855	143	Bristol.
..	32	..	32	6	..	40	..	40	7	..	146	2	148	30	Gloucester.
..	67	..	67	8	..	122	1	123	18	1	262	3	266	43	Burton-on-Trent
..	232	9	241	39	..	161	7	168	43	..	618	24	642	122	Wolverhampton.
..	124	1	125	19	..	107	3	110	24	..	388	9	397	71	Walsall.
..	143	2	145	22	..	137	2	139	27	..	433	8	441	73	West Bromwich
..	53	..	53	8	..	30	..	30	6	..	167	4	171	24	Worcester.
..	59	4	63	7	..	50	..	50	10	1	159	5	165	32	Smethwick.
..	633	11	644	134	4	793	10	807	146	5	2,483	41	2,529	484	Birmingham.
..	132	5	137	18	..	107	1	108	17	..	357	10	367	57	Aston Manor.
..	68	7	75	15	..	42	5	47	12	..	182	19	201	39	Coventry.
..	513	..	513	57	..	435	..	435	67	..	1,383	..	1,383	192	Leicester.
4	482	11	497	53	..	220	31	251	55	4	880	73	957	141	Grimsby.
..	569	..	569	65	..	768	..	768	103	..	2,141	..	2,141	313	Nottingham.
..	149	..	149	29	..	209	..	209	43	..	544	..	544	113	Derby.

In Registration Divisions.	Urban Sanitary Districts.	Population (1891).	"FEVER"—*continued.*									
			1st Quarters, 1893-97.					2nd Quarters, 1893-97.				
			Notifications.					Notifications.				
			Typhus.	Enteric.	Continued.	Total.	Deaths.	Typhus.	Enteric.	Continued.	Total.	Deaths.
VIII. North-Western.	Stockport	70,263	..	39	7	46	9	..	42	4	46	10
	Macclesfield	36,000	..	16	..	16	7	..	17	2	19	1
	Birkenhead	99,857	1	164	6	171	27	7	163	..	170	26
	Liverpool	629,443	293	927	95	1,315	212	301	1,315	115	1,731	232
	St. Helens (Lancs.)	71,288	3	161	1	165	48	1	88	1	90	17
	Southport	41,406	..	37	1	38	5	..	21	..	21	2
	Wigan	55,013	34	92	32	158	14	10	61	19	90	7
	Warrington	52,743	1	51	2	54	16	..	14	2	16	2
	Bolton	115,002	1	210	1	212	55	..	102	1	103	18
	Bury (Lancs.)	57,212	..	58	8	66	13	2	80	7	89	18
	Salford	198,139	3	311	15	329	78	2	335	16	353	82
	Manchester	505,368	4	586	..	590	147	1	436	..	437	102
	Ashton-under-Lyne ..	40,463	..	62	7	69	18	..	38	9	47	12
	Oldham	131,463	3	106	..	109	22	..	89	..	89	21
	Accrington	38,603	..	32	1	33	6	..	43	..	43	5
	Burnley	87,016	..	124	..	124	23	3	130	2	135	22
	Blackburn	120,064	1	188	..	189	44	1	130	4	135	39
	Darwen	34,192	..	42	1	43	7	..	50	1	51	13
	Preston..	107,573	..	138	..	138	29	1	82	..	83	19
	Barrow-in-Furness ..	51,712	..	54	34	88	8	2	48	18	68	7
IX. Yorkshire.	Huddersfield	95,420	..	31	1	32	7	2	43	..	45	10
	Halifax..	89,832	..	95	5	100	21	..	62	2	64	13
	Bradford	216,361	..	144	..	144	35	..	96	1	97	28
	Barnsley	35,427	..	91	..	91	15	1	41	..	42	9
	Sheffield	324,243	..	436	21	457	77	..	269	16	285	63
	Rotherham	42,061	..	58	..	58	14	2	68	..	70	15
	York	67,004	..	54	3	57	4	..	59	7	66	11
	Hull	200,044	1	201	26	228	38	..	184	18	202	34
	Middlesbrough	75,532	..	225	12	237	43	..	168	4	172	30
X. Northern.	Darlington	38,060	..	43	2	45	8	..	19	3	22	2
	Sunderland	131,015	14	219	54	287	66	4	194	47	245	33
	South Shields	78,391	..	86	10	96	29	..	85	8	93	28
	Newcastle-on-Tyne ..	186,300	..	201	17	218	45	3	129	20	152	35
	Tynemouth	46,588	..	38	2	40	8	..	29	..	29	5
	Carlisle..	39,176	1	21	3	25	3	1	12	1	14	4
XI. Welsh.	Newport (Mon.) .. .	54,707	4	73	7	84	14	..	60	2	62	11
	Cardiff	128,915	34	101	4	139	27	4	70	3	77	14
	Merthyr Tydfil	58,080	..	146	2	148	18	..	100	..	100	14
	Swansea	90,349	..	140	..	140	15	..	130	..	130	15
	Totals, 76 Districts ..	11,876,097	431	12,459	588	13,478	2,596	373	10,631	568	11,572	2,026

App. A, No. 13.

Compilation of Returns of Notified Infectious Diseases, and registered Deaths therefrom, 1893-97.

"FEVER"—*continued.*															
3rd Quarters, 1893-97.					4th Quarters, 1893-97.					Total for Quinquenniad, 1893-97.					Urban Sanitary Districts.
Notifications.					Notifications.					Notifications.					
Typhus.	Enteric.	Continued.	Total.	Deaths.	Typhus.	Enteric.	Continued.	Total.	Deaths.	Typhus.	Enteric.	Continued.	Total.	Deaths.	
..	247	11	258	49	..	192	5	197	52	..	520	27	547	120	Stockport.
..	45	3	48	7	..	42	1	43	2	..	120	6	126	17	Macclesfield.
6	248	..	254	39	2	317	6	325	47	16	892	12	920	139	Birkenhead.
238	1,896	115	2,249	308	290	1,907	121	2,318	375	1,122	6,045	446	7,613	1,127	Liverpool.
..	429	6	435	68	..	380	3	383	82	4	1,058	11	1,073	215	St. Helens (Lancs.)
..	64	..	64	13	..	65	1	66	16	..	187	2	189	36	Southport.
10	168	43	221	22	39	233	52	324	45	93	554	146	793	88	Wigan.
..	60	1	61	13	..	63	..	63	15	1	188	5	194	46	Warrington.
..	231	1	232	48	..	288	..	288	67	1	831	3	835	188	Bolton.
8	88	32	128	35	..	89	14	103	21	10	315	61	386	87	Bury (Lancs.)
..	588	30	618	90	1	641	27	669	138	6	1,875	88	1,969	388	Salford.
2	637	..	639	103	..	940	..	940	194	7	2,599	..	2,606	546	Manchester.
..	56	11	67	10	..	81	21	102	21	..	237	48	285	61	Ashton-under-Lyne.
1	99	..	100	17	1	160	..	161	50	5	454	..	459	110	Oldham.
..	76	..	76	8	..	106	1	107	20	..	257	2	259	39	Accrington.
2	150	..	152	35	2	160	..	162	37	7	564	2	573	117	Burnley.
..	151	..	151	41	1	253	..	254	40	3	722	4	729	164	Blackburn.
1	32	1	34	10	..	57	3	60	11	1	181	6	188	41	Darwen.
..	248	..	248	57	..	310	2	312	58	1	778	2	781	163	Preston.
..	56	20	76	13	..	57	28	85	25	2	215	100	317	53	Barrow-in-Furness.
..	97	..	97	14	..	112	..	112	27	2	283	1	286	58	Huddersfield.
..	69	3	72	15	..	136	3	139	22	..	362	13	375	71	Halifax.
..	230	2	232	39	..	361	7	368	76	..	831	10	841	178	Bradford.
..	183	6	189	37	..	281	9	290	47	1	596	15	612	108	Barnsley.
..	976	32	1,008	149	..	958	31	989	174	..	2,639	100	2,739	462	Sheffield.
1	124	..	125	28	1	113	2	116	24	4	363	2	369	81	Rotherham.
..	379	13	392	47	..	254	1	255	38	..	746	24	770	100	York.
..	767	68	835	114	..	577	57	634	119	1	1,729	169	1,899	305	Hull.
..	241	6	247	36	..	389	18	407	63	..	1,023	40	1,063	172	Middlesbrough.
..	140	12	152	19	..	118	4	122	19	..	320	21	341	48	Darlington.
20	1,326	140	1,486	163	11	975	132	1,118	174	49	2,714	373	3,136	436	Sunderland.
..	228	25	253	43	..	202	30	232	63	..	601	73	674	163	South Shields.
..	201	27	228	25	1	308	25	334	62	4	839	89	932	167	Newcastle-on-Tyne.
..	77	..	77	9	..	66	..	66	21	..	210	2	212	43	Tynemouth.
..	24	..	24	3	..	29	..	29	4	2	86	4	92	14	Carlisle.
..	115	5	120	16	1	59	5	65	8	5	307	19	331	49	Newport (Mon.)
..	135	8	143	18	1	132	10	143	26	39	438	25	502	85	Cardiff.
..	254	5	259	40	..	241	5	246	26	..	741	12	753	98	Merthyr Tydfil.
1	164	..	165	16	..	195	..	195	27	1	629	..	630	73	Swansea.
317	21,700	922	22,939	3,483	379	24,262	958	25,599	4,606	1,500	69,052	3,036	73,588	12,711	Totals, 76 Districts.

No. 13A.

TABLE showing during the Five-Year Period 1893-97, for each of the **SANITARY AREAS** within **QUARTERLY NUMBERS** of **NOTIFIED CASES** and of **REGISTERED DEATHS** from the following question.

[The Cases are totals of the Weekly Returns of Notifiable Diseases received by the Board from the Metropolitan

District	Sanitary Areas.	Population (1891).	SMALL-POX.											
			Weekly Statement, 1st Quarters, 1893–97.¶											
			1st week, Jan. 9.		2nd week, Jan. 16.		3rd week, Jan. 23.		4th week, Jan. 30.		5th week, Feb. 6.		6th week, Feb. 13.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
	London (*Administrative County.*)	4,232,118	40	1	65	5	55	3	61	..	94	8	84	5
W. District.	Kensington	166,308	4	..	..	..	2	..	5	..	..	1	..	..
	Fulham	91,639	..	..	..	..	..	..	..	..	2	..	3	..
	Hammersmith	97,239	2	..	2	..	..	..	..	..	..	..	..	..
	Paddington	117,846	3	..	1	1	..	..	1	..	..	..	2	..
	Chelsea	96,253	..	..	3	..	1	..	3	..	2	..	1	..
	St. George, Hanover Sq.*	78,599	..	..	..	..	..	..	2	..	..	..	..	..
	Westminster	55,539	1	..	2	..	1	..	1	..	..	..	1	..
	St. James, Westminster	24,995	..	..	..	..	..	..	..	..	..	..	..	..
N. District.	St. Marylebone	142,404	3	..	6	..	10	1	6	..	31	2	10	3
	Hampstead	68,416	..	..	..	..	..	..	..	..	..	..	..	..
	St. Pancras	234,379	3	..	3	..	3	..	2	..	1	1	..	..
	Islington	319,143	2	..	3	..	3	..	4	..	4	..	3	..
	St. Mary, Stoke Newington	30,936	1	..	..	..	3	..	3	..	6	1	2	..
	Hackney	198,606												
Central District.	St. Giles and St. George, Bloomsbury.	39,782	..	..	..	..	..	..	4	..	2	..	2	..
	St. Martin-in-the-Fields	14,616	..	..	..	..	..	..	1	..	..	..	..	..
	Strand†	25,217	..	..	..	..	.	..	..	..	..	..	1	..
	Holborn‡	34,043	..	..	..	..	..	..	1	..	..	..	1	..
	Clerkenwell	66,216	..	..	1	..	..	..	..	..	1	..	2	..
	St. Luke, Middlesex	42,440	1	..	1	..	1	..	1	..	..	..	1	..
	London, City of§	37,583	..	.	..	..	..	..	..	..	1	..	..	..
E. District.	Shoreditch	124,009	1	..	..	1	1	..	1	..	..	..	..	..
	Bethnal Green	129,132	..	..	..	..	1	..	1	..	..	..	..	..
	Whitechapel‖	74,420	..	..	4	..	1	..	5	..	..	1	1	..
	St. George-in-the-East	45,795	..	..	1	..	1	..	3	..	2	..	..	..
	Limehouse	57,376	..	..	2	..	..	..	..	..	2	..	1	..
	Mile End Old Town	107,592	..	1	4	..	1	..	1	..	1	..	4	..
	Poplar	166,748	6	..	4	..	3	..	5	..	4	1	5	..
S. District.	St. Saviour, Southwark	27,177	..	..	1	..	1	..	..	..	..	..	1	..
	St. George, Southwark	59,712	1	..	1	..	..	..	1	..	1	..	1	..
	Newington	115,804	..	..	1	..	4	1	..	..	..	..	..	..
	St. Olave, Southwark	12,723	..	..	..	..	..	..	..	..	..	..	..	..
	Bermondsey	84,682	..	..	2	..	1	..	1	..	2	..	4	..
	Rotherhithe	39,255	..	..	3	..	..	..	..	..	6	..	..	..
	Lambeth	275,203	1	..	2	1	4	..	..	..	3	..	2	..
	Battersea	150,558	..	..	6	..	2	..	..	..	1	..	..	..
	Wandsworth	156,942	..	..	..	..	1	..	..	..	..	..	..	..
	Camberwell	235,344	4	..	4	1	3	..	1	..	9	..	26	1
	Greenwich	165,413	4	..	4	1	4	1	1	..	10	1	4	1
	Lewisham	92,647	..	..	1	..	1	..	2	..	1	..	2	..
	Woolwich	40,848	..	..	..	..	2	..	..	..	2	..	..	..
	Plumstead	52,436	..	..	1	..	..	..	2	..	..	..	1	..
	Lee	36,103												
	Port of London	..	3	..	2	..	..	..	3	..	..	..	3	..

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* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95), ‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

No. 13A.

the ADMINISTRATIVE COUNTY of LONDON and for the COUNTY as a WHOLE, the WEEKLY and
DISEASES, together with a QUINQUENNIAL SUMMARY of these Data for each of the AREAS in

Asylums Board. The Deaths are totals of extracts from the Weekly Returns compiled by the Registrar-General.]

SMALL-POX—*continued.*																
Weekly Statement, 1st Quarters, 1893-97—*continued.*¶														Totals for 1st Quarters, 1893-97.		Sanitary Areas.
7th week, Feb. 20.		8th week, Feb. 27.		9th week, Mar. 6.		10th week, Mar. 13.		11th week, Mar. 20.		12th week, Mar. 27.		13th week, April 3.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
92	2	115	7	86	12	100	8	78	4	132	5	92	5	1,094	65	London. (*Administrative County.*)
..	..	6	..	2	..	1	1	..	..	1	..	1	..	22	2	Kensington.
7	..	3	..	6	..	2	..	2	..	2	..	5	..	32	..	Fulham.
..	..	8	1	5	..	..	..	3	1	..	..	..	..	15	2	Hammersmith.
2	..	..	..	1	..	..	..	..	..	1	..	2	..	13	1	Paddington.
..	..	..	..	..	..	..	..	1	..	1	..	1	..	13	..	Chelsea.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	St. George, Hanover Sq.*
1	..	.	..	2	..	..	..	1	..	7	..	3	..	20	..	Westminster.
..	..	..	..	..	..	..	..	..	..	2	..	1	..	3	..	St. James, Westminster.
8	1	19	2	5	..	5	..	6	1	14	..	4	..	127	10	St. Marylebone.
..	..	..	..	..	..	..	..	..	..	..	..	2	..	2	..	Hampstead.
1	1	2	..	1	..	3	..	4	..	5	..	5	..	33	2	St. Pancras.
..	..	6	..	4	..	24	..	3	..	10	..	3	..	69	..	Islington.
..	..	3	..	2	..	3	..	5	..	7	..	1	..	35	1	St. Mary, Stoke Newington. Hackney.
2	..	..	..	4	..	3	1	6	..	1	..	2	1	26	2	St. Giles and St. George Bloomsbury.
..	..	..	..	..	1	..	..	..	..	1	..	..	..	2	1	St. Martin-in-the-Fields.
1	..	5	..	..	2	1	..	..	..	2	..	2	..	12	2	Strand.†
1	..	1	..	4	..	..	..	3	..	..	..	3	1	14	1	Holborn.‡
7	..	1	..	..	..	2	..	1	..	1	..	3	..	19	..	Clerkenwell.
1	..	1	..	..	..	1	1	..	..	..	..	1	..	9	1	St. Luke, Middlesex.
..	..	1	1	..	..	1	..	1	..	2	..	..	..	6	1	London, City of.§
2	..	2	..	2	1	1	..	2	..	1	..	1	1	14	3	Shoreditch.
3	..	1	..	..	..	2	..	1	..	2	..	1	..	12	..	Bethnal Green.
7	..	4	..	1	..	10	1	4	..	10	..	2	..	49	2	Whitechapel.‖
10	..	6	..	6	..	..	..	1	..	1	..	1	1	32	1	St. George-in-the-East.
1	..	3	..	2	..	2	..	..	..	6	1	1	..	20	1	Limehouse.
..	..	1	..	..	..	6	..	2	..	3	..	3	..	26	1	Mile End Old Town.
11	..	8	..	16	..	7	..	6	..	7	..	10	..	92	1	Poplar.
..	..	1	..	..	..	..	..	..	..	..	..	..	..	4	..	St. Saviour, Southwark.
2	..	1	..	2	..	..	1	..	..	2	..	2	..	14	1	St. George, Southwark.
1	..	1	..	..	1	..	..	2	..	..	..	3	..	12	2	Newington.
1	..	..	..	5	1	..	..	..	..	..	..	..	..	6	1	St. Olave, Southwark.
3	..	..	..	1	..	5	..	..	1	2	..	2	..	23	1	Bermondsey.
1	..	1	..	..	..	..	..	5	..	4	..	4	.	24	..	Rotherhithe.
1	..	5	..	2	..	3	2	2	..	3	..	1	..	29	3	Lambeth.
1	.	1	..	1	..	3	..	..	..	1	..	1	..	17	..	Battersea.
1	..	..	..	..	..	..	..	..	..	1	..	..	..	3	..	Wandsworth.
4	..	15	1	2	4	2	..	1	..	5	1	1	..	77	8	Camberwell.
8	..	3	..	5	1	6	1	6	..	20	2	9	1	84	9	Greenwich.
1	..	..	..	..	..	..	..	2	..	..	1	5	..	15	1	Lewisham.
1	..	1	1	2	..	6	..	6	..	4	..	4	..	28	1	Woolwich.
2	..	8	1	2	1	2	..	2	1	2	..	2	..	24	3	Plumstead. Lee.
..	..	2	..	1	..	..	..	..	..	1	..	..	..	15	..	Port of London.

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§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

¶ The actual dates of the registration weeks in 1897 have been given as perhaps aiding the reader.

SMALL-POX—*continued.*

Weekly Statement, 2nd Quarters, 1893-97.¶

	Sanitary Areas.	Population (1891).	14th week, April 10.		15th week, April 17.		16th week, April 24.		17th week, May 1.		18th week, May 8.		19th week, May 15.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
	London .. .. *(Administrative County.)*	4,232,118	141	4	204	8	170	11	179	10	231	12	187	15
W. District.	Kensington	166,308	2	..	2	..	1	..	6	..	2	1	7	..
	Fulham	91,639	2	..	3	..	1	1	2	..	2	1	2	..
	Hammersmith	97,239	4	..	1	..	2	..	2	..	4	..	2	..
	Paddington	117,846	2	..	5	..	2	1	7	..	..	..	3	..
	Chelsea	96,253	1	..	3	..	1	..	5	..	3	..	2	..
	St. George, Hanover Sq.* ..	78,599	..	..	2	..	2	1	..	1	1	..	..	..
	Westminster	55,539	5	..	3	..	1	..	2	..	4	..	5	..
	St. James, Westminster ..	24,995	..	..	1	..	..	..	2	..	..	..	3	..
N. District.	St. Marylebone	142,404	3	..	16	..	15	..	10	..	16	..	11	..
	Hampstead	68,416	2	1	..	..	2	..	..	..	3	..	1	..
	St. Pancras	234,379	3	..	9	..	12	..	10	..	12	..	11	..
	Islington	319,143	17	1	16	..	21	..	9	..	14	..	16	1
	St. Mary, Stoke Newington	30,936	1	..	5	..	2	..	5	..	6	..	3	..
	Hackney	198,606												
Central District.	St. Giles and St. George, Bloomsbury.	39,782	2	..	11	..	2	..	8	..	5	1	6	1
	St. Martin-in-the-Fields ..	14,616	..	..	2	..	2	1	2	1	..	..	..	..
	Strand†	25,217	1	..	10	..	2	..	5	..	5	..	1	1
	Holborn‡	34,043	3	..	1	..	9	..	9	..	6	1	4	..
	Clerkenwell	66,216	2	..	1	..	..	..	..	..	1	..	2	..
	St. Luke, Middlesex ..	42,440	..	..	2	..	1	..	..	1	4	..	2	..
	London, City of§	37,583	1	..	1	..	3	..	1	1	1	..	2	..
E. District.	Shoreditch	124,009	3	..	4	..	3	..	1	1	1	..	3	..
	Bethnal Green	129,132	3	..	2	..	2	..	3	..	5	..	9	..
	Whitechapel‖	74,420	8	1	4	..	4	2	5	..	9	..	2	..
	St. George-in-the-East ..	45,795	1	..	..	..	3	..	3	..	2	..	..	..
	Limehouse	57,376	8	..	7	..	2	..	3	..	7	..	4	1
	Mile End Old Town ..	107,592	12	..	7	..	11	..	7	..	17	1	4	1
	Poplar	166,748	12	..	11	..	12	1	11	1	27	..	23	4
S. District.	St. Saviour, Southwark ..	27,177	..	..	..	..	1	..	..	..	..	..	..	..
	St. George, Southwark ..	59,712	4	..	3	1	2	..	2	..	2	..	5	..
	Newington	115,804	1	..	5	..	..	1	4	..	4	1	6	..
	St. Olave, Southwark ..	12,723	1	..	..	..	..	..	..	..	1	..	1	..
	Bermondsey	84,682	..	..	6	..	1	..	4	1	1	1	8	..
	Rotherhithe	39,255	..	..	4	..	..	..	18	1	25	2	11	2
	Lambeth	275,203	7	..	6	..	8	..	7	..	3	..	5	..
	Battersea	150,558	1	.	3	..	2	..	1	1	2	..	5	1
	Wandsworth	156,942	..	.	1	..	..	..	2	..	6	..	1	1
	Camberwell	235,344	5	..	10	1	11	..	4	1	7	..	5	1
	Greenwich	165,413	20	..	27	..	13	3	13	..	8	..	3	..
	Lewisham	92,647	1	..	1	1	5	..	..	..	3	2	..	..
	Woolwich	40,848	..	..	1	..	3	..	1	..	3	1	3	..
	Plumstead	52,436	3	1	6	..	3	..	4	..	9	..	6	1
	Lee	36,103												
	Port of London	..	1	..	2	..	3	..	1	..	..	..	..	..

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* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population 21), and Furnival's Inn (population, 121).

SMALL-POX—*continued.*																
Weekly Statement, 2nd Quarters, 1893-97—*continued.*¶														Totals for 2nd Quarters, 1893-97.		Sanitary Areas.
20th week, May 22.		21st week, May 29.		22nd week, June 5.		23rd week, June 12.		24th week, June 19.		25th week, June 26.		26th week, July 3.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
172	7	218	22	204	13	139	10	169	7	158	13	132	5	2,304	132	London. (*Administrative County.*)
5	..	..	1	1	..	1	..	1	..	1	..	..	..	29	2	Kensington.
4	..	1	..	4	..	..	..	..	..	1	..	..	..	22	2	Fulham.
..	..	..	..	1	..	1	..	..	1	2	..	1	1	20	2	Hammersmith.
2	..	8	..	6	1	2	1	..	..	2	..	..	1	39	4	Paddington.
..	..	2	..	6	..	3	..	..	..	..	..	2	..	28	..	Chelsea.
2	..	6	1	..	..	1	..	2	..	3	..	1	..	20	3	St. George, Hanover Sq.*
..	..	..	..	2	..	1	..	3	..	1	..	2	..	29	..	Westminster.
..	..	2	..	..	..	5	..	16	..	14	..	7	..	50	..	St. James, Westminster.
13	..	17	..	11	2	4	..	5	..	7	..	5	..	133	2	St. Marylebone
3	1	1	1	1	..	..	..	4	..	..	..	..	..	17	3	Hampstead.
12	..	9	4	24	..	10	2	8	1	7	1	6	..	133	8	St. Pancras.
11	..	14	..	6	..	11	..	12	..	18	..	6	..	171	2	Islington.
7	..	10	..	2	1	1	..	2	..	2	..	1	..	47	1	St.Mary,StokeNewington. Hackney.
3	..	3	1	1	..	6	..	2	..	6	..	1	1	56	4	St. Giles and St. George, Bloomsbury.
1	..	1	..	1	..	1	..	..	..	1	..	1	..	12	2	St. Martin-in-the-Fields.
..	..	3	..	..	..	3	..	1	..	..	..	3	..	34	1	Strand.†
2	..	5	..	2	..	..	..	6	..	..	..	5	..	51	1	Holborn.‡
1	..	1	..	1	..	..	1	1	..	3	..	..	..	13	1	Clerkenwell.
2	..	1	..	2	..	..	..	1	..	3	..	..	..	18	1	St. Luke, Middlesex.
1	..	4	..	3	1	1	..	2	..	..	..	3	..	23	2	London, City of.
5	1	4	..	1	..	1	..	1	..	1	..	3	..	31	2	Shoreditch.
4	..	16	..	15	..	10	1	15	..	7	3	6	..	97	4	Bethnal Green.
11	..	2	..	6	..	3	..	2	..	1	..	1	..	58	3	Whitechapel.‖
1	..	1	..	..	..	2	..	2	..	2	..	..	..	17	..	St. George-in-the-East.
3	..	9	..	3	1	..	..	3	2	7	..	5	1	61	5	Limehouse.
11	1	12	2	15	1	5	..	5	..	6	..	1	..	113	6	Mile End Old Town.
10	1	11	3	7	1	12	..	11	..	13	3	5	..	165	14	Poplar.
..	..	..	..	..	..	1	..	5	..	..	..	..	..	7	..	St. Saviour, Southwark.
7	..	10	2	10	2	5	..	8	..	3	..	4	..	65	5	St. George, Southwark.
5	1	2	..	5	..	10	1	16	..	6	1	6	..	70	5	Newington.
1	..	..	..	1	..	1	..	..	..	1	..	..	..	7	..	St Olave, Southwark.
6	..	5	..	..	1	2	..	3	..	2	..	6	..	44	3	Bermondsey.
16	1	1	4	6	..	..	1	4	..	2	2	2	..	89	13	Rotherhithe.
2	..	14	..	14	1	7	..	4	..	11	..	18	..	106	1	Lambeth.
1	..	16	..	5	..	12	..	4	1	3	1	12	1	68	5	Battersea.
1	..	1	..	5	..	1	..	1	..	1	..	1	..	21	1	Wandsworth.
10	1	5	1	12	1	2	2	5	..	8	..	12	..	95	8	Camberwell.
2	..	8	..	12	..	8	1	6	1	4	2	3	..	127	7	Greenwich.
2	..	1	1	1	..	1	..	..	..	1	..	..	..	16	4	Lewisham.
2	..	7	..	5	..	2	..	4	1	1	..	1	..	33	2	Woolwich.
8	..	3	1	7	..	2	..	3	..	5	..	2	..	56	3	Plumstead. Lee.
..	..	2	..	..	..	1	..	1	..	2	..	..	..	13	..	Port of London.

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‡ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

¶ The actual dates of the registration weeks in 1897 have been given as perhaps aiding the reader.

	Sanitary Areas.	Population (1891).	SMALL-POX—*continued*.											
			Weekly Statement, 3rd Quarters, 1893-97.¶											
			27th week, July 10.		28th week, July 17.		29th week, July 24.		30th week, July 31.		31st week, Aug. 7.		32nd week, Aug. 14.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
	London .. .. (*Administrative County.*)	4,232,118	134	14	135	6	91	11	337	11	230	10	113	15
W. District.	Kensington	166,308	2	1	1	..	4	..	..	..	2	..	1	..
	Fulham	91,639	1	..	..	..	..	..	..	..	..	..	..	..
	Hammersmith	97,239	1	..	..	..	..	..	..	..	1	..	1	..
	Paddington	117,846	1	..	1	..	3	..	3	..	10	1	4	..
	Chelsea	96,253	2	..	2	..	..	..	1	..	2	..	2	..
	St. George, Hanover Sq.* ..	78,599	1	..	1	..	2	..	1	..	2	..	..	..
	Westminster	55,539	..	..	1	..	..	..	..	..	3	..	1	..
	St. James, Westminster ..	24,995	5	..	3	..	1	1	2	..	1	..	2	1
N. District.	St. Marylebone	142,404	12	..	5	1	3	..	154	..	62	4	12	7
	Hampstead	68,416	1	..	..	..	..	..	4	..	3	..	5	2
	St. Pancras	234,379	5	2	7	..	2	1	13	1	13	1	3	..
	Islington	319,143	4	1	10	..	6	..	7	2	7	1	1	..
	St. Mary, Stoke Newington	30,936	7	1	6	..	1	1	9	..	3	..	2	..
	Hackney	198,606												
Central District.	St. Giles and St. George, Bloomsbury.	39,782	5	..	4	..	3	..	4	..	1	..	2	..
	St. Martin-in-the-Fields ..	14,616	..	..	1	..	..	..	..	..	2	..	..	..
	Strand†	25,217	1	1	1	..	1	..	1	..	1	1	..	..
	Holborn‡	34,043	1	..	3	..	3	..	1	..	1	..	3	..
	Clerkenwell	66,216	1	..	1	..	..	..	2	..	1	..	2	..
	St. Luke, Middlesex ..	42,440	3	..	1	..	1	..	..	..	3	..	..	..
	London, City of§	37,583	..	..	..	..	2	..	4	1	1	..	..	..
E. District.	Shoreditch	124,009	3	..	3	1	2	..	4	..	..	..	2	1
	Bethnal Green	129,132	10	..	9	..	4	2	16	1	27	..	6	..
	Whitechapel‖	74,420	2	..	4	..	8	..	43	..	13	..	10	2
	St. George-in-the-East ..	45,795	2	..	2	..	..	..	4	..	2	..	7	..
	Limehouse	57,376	2	2	7	..	1	..	..	..	5	..	..	..
	Mile End Old Town ..	107,592	3	..	2	..	2	..	14	..	21	2	3	1
	Poplar	166,748	2	..	9	..	2	..	3	1	8	..	3	..
S. District.	St. Saviour, Southwark ..	27,177	..	..	1	..	..	..	..	..	..	..	1	..
	St. George, Southwark ..	59,712	2	1	9	..	11	..	9	1	6	..	3	..
	Newington	115,804	5	..	3	1	2	..	4	..	1	..	7	..
	St. Olave, Southwark ..	12,723	..	..	1	..	..	..	..	..	..	..	..	..
	Bermondsey	84,682	3	1	1	..	..	..	1	..	1	..	2	..
	Rotherhithe	39,255	3	..	1	..	5	..	1	1	4	..	..	..
	Lambeth	275,203	5	1	11	..	1	1	12	1	5	..	10	..
	Battersea	150,558	10	..	10	2	14	4	7	1	6	..	6	..
	Wandsworth	156,942	2	..	2	..	1	..	1	..	..	..	4	..
	Camberwell	235,344	17	3	7	1	2	..	7	..	9	..	6	..
	Greenwich	165,413	7	..	4	..	..	1	..	..	..	..	..	..
	Lewisham	92,647	..	..	..	..	..	..	..	..	1	..	..	..
	Woolwich	40,848	1	..	1	..	2	..	1	1	..	..	..	1
	Plumstead	52,436	2	..	..	..	2	..	4	..	3	..	2	..
	Lee	36,103												
	Port of London	..	..	..	..	..	..	..	..	..	..	..	..	..

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* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

SMALL-POX—*continued.*

Weekly Statement, 3rd Quarters, 1893-97—*continued.*¶

33rd week, Aug. 21.		34th week, Aug. 28.		35th week, Sept. 4.		36th week, Sept. 11.		37th week, Sept. 18.		38th week, Sept. 25.		39th week, Oct. 2.		Totals for 3rd Quarters, 1893-97.		Sanitary Areas.
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
178	8	140	10	152	13	91	11	96	6	62	4	60	5	1,819	124	London. (*Administrative County.*)
..	..	1	..	1	..	..	..	7	..	3	..	1	..	23	1	Kensington.
1	..	..	..	5	..	6	1	..	1	2	..	3	..	18	2	Fulham.
..	..	1	..	..	..	..	..	..	..	..	..	1	..	5	..	Hammersmith.
2	1	1	..	1	..	1	..	1	..	..	..	2	..	30	2	Paddington.
..	..	..	..	1	..	..	..	1	..	..	..	..	..	11	..	Chelsea.
1	..	1	..	..	..	4	..	1	1	1	..	1	..	16	1	St. George, Hanover Sq.*
..	..	..	..	..	..	1	..	2	..	..	..	..	..	8	..	Westminster.
1	..	..	..	..	..	..	..	..	..	..	..	..	..	15	2	St. James, Westminster.
36	2	33	2	76	6	2	4	13	1	4	..	7	1	419	28	St. Marylebone.
2	..	1	..	3	..	..	..	..	..	..	..	..	..	19	2	Hampstead.
4	1	3	..	5	..	4	1	7	..	3	..	..	..	69	7	St. Pancras.
4	..	1	..	13	..	4	1	2	1	6	..	3	..	68	6	Islington.
4	..	2	..	3	..	5	..	3	..	3	..	2	2	50	4	St.Mary,StokeNewington. Hackney.
2	..	..	1	..	..	..	..	1	..	..	..	..	..	22	1	St. Giles and St. George, Bloomsbury.
..	1	..	..	..	..	..	..	..	..	1	..	..	..	4	1	St. Martin-in-the-Fields.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	5	2	Strand.†
2	..	3	..	2	..	1	..	..	..	1	..	..	..	21	..	Holborn.‡
5	..	2	..	1	..	1	..	..	..	..	..	..	..	16	..	Clerkenwell.
1	..	2	..	..	..	..	..	..	..	..	..	..	..	11	..	St. Luke, Middlesex.
..	..	..	..	..	..	..	..	1	..	..	..	..	..	8	1	London, City of.§
6	..	2	..	..	..	2	..	2	1	6	1	..	..	32	4	Shoreditch.
16	..	27	2	6	3	20	..	14	..	5	2	9	..	169	10	Bethnal Green.
11	..	9	..	2	1	4	1	5	..	1	..	1	..	113	4	Whitechapel.‖
3	..	1	..	1	..	2	..	2	..	1	..	..	..	27	..	St. George-in-the-East.
3	..	..	..	1	..	1	..	1	..	..	..	2	..	23	2	Limehouse.
9	..	5	..	8	1	3	..	2	..	2	..	..	1	74	5	Mile End Old Town.
13	1	5	..	3	1	4	..	8	..	1	..	6	..	67	3	Poplar.
1	..	4	..	..	..	3	..	1	..	4	..	..	..	15	..	St. Saviour, Southwark.
9	..	3	..	..	..	..	..	2	..	2	..	6	..	62	2	St. George, Southwark.
3	1	..	2	..	..	1	..	..	..	1	..	..	..	27	4	Newington.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	St. Olave, Southwark.
2	..	..	..	..	..	1	..	..	..	..	..	..	..	11	1	Bermondsey.
15	..	3	..	..	..	..	..	..	..	..	..	..	..	32	1	Rotherhithe.
9	1	4	..	2	..	5	..	1	1	2	..	5	1	72	6	Lambeth.
2	..	4	..	4	1	2	..	3	..	5	..	3	..	76	8	Battersea.
1	..	5	1	1	..	5	..	1	..	1	..	2	..	26	1	Wandsworth.
6	..	7	1	8	..	4	2	8	..	4	..	4	..	89	7	Camberwell.
..	..	..	..	4	..	2	..	2	..	..	1	..	..	19	2	Greenwich.
..	..	2	..	..	..	..	..	..	..	1	..	..	..	4	..	Lewisham.
1	..	2	..	..	..	..	..	..	..	2	..	2	..	12	2	Woolwich.
2	..	4	1	1	..	3	1	5	..	..	.. ..	..	..	27	2	Plumstead. Lee.
1	..	2	..	..	..	..	..	..	..	..	..	..	..	3	..	Port of London.

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§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

¶ The actual dates of the registration weeks in 1897 have been given as perhaps aiding the reader.

	Sanitary Areas.	Population (1891).	SMALL-POX—*continued.*													
			Weekly Statement, 4th Quarters, 1893-97.¶													
			40th week, Oct. 9.		41st week, Oct. 16.		42nd week, Oct. 23.		43rd week, Oct. 30.		44th week, Nov. 6.		45th week, Nov. 13.		46th week, Nov. 20.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
	London .. .. (*Administrative County.*)	4,232,118	56	8	44	4	30	1	48	3	53	3	85	4	38	1
W. District.	Kensington	166,308	1	..	..	..	1	..	6	1	13	..	21	..	10	..
	Fulham	91,639	2	1	2	..	1	..	2	..	1	..	..	..	..	..
	Hammersmith	97,239	..	..	..	..	..	..	..	..	..	..	1	..	..	..
	Paddington	117,846	..	..	2	..	..	..	5	..	2	..	13	1	..	..
	Chelsea..	96,253	..	..	..	..	1	..	1	1	2	..	8	1	..	..
	St. George, Hanover Sq.* ..	78,599	..	..	..	..	2	..	..	..	1	1	..	..	..	..
	Westminster	55,539	1	..	..	..	..	..	..	..	..	..	..	..	..	..
	St. James, Westminster ..	24,995	..	..	..	..	..	..	..	..	..	..	..	..	..	..
N. District.	St. Marylebone	142,404	2	1	3	..	2	..	4	..	6	..	4	..	1	..
	Hampstead	68,416	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	St. Pancras	234,379	2	..	..	..	2	..	4	..	1	..	3	..	1	..
	Islington	319,143	2	..	1	..	..	..	..	..	..	..	1	..	..	..
	St. Mary, Stoke Newington	30,936	2	..	..	..	1	..	..	..	..	..	..	..	..	..
	Hackney	198,606														
Central District.	St. Giles and St. George, Bloomsbury.	39,782	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	St. Martin-in-the-Fields ..	14,616	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Strand†	25,217	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Holborn‡	34,043	1	..	..	..	1	..	..	..	..	..	..	..	..	..
	Clerkenwell	66,216	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	St. Luke, Middlesex ..	42,440	..	..	..	..	..	..	1	..	..	..	..	..	..	..
	London, City of§	37,583	..	..	..	..	..	..	..	..	..	..	1	..	2	..
E. District.	Shoreditch	124,009	..	..	4	..	..	..	..	..	..	..	..	..	1	..
	Bethnal Green	129,132	14	..	2	1	3	1	..	..	1	..	1	..	2	..
	Whitechapel‖	74,420	1	..	3	..	..	..	..	..	..	..	..	..	..	..
	St. George-in-the-East ..	45,795	2	..	..	..	..	..	..	..	1	..	..	..	..	..
	Limehouse	57,376	1	..	1	1	1	..	4	..	3	..	2	1	3	..
	Mile End Old Town ..	107,592	1	..	2	..	..	..	..	..	2	..	..	..	..	1
	Poplar	166,748	2	..	5	1	2	..	10	..	7	1	13	..	11	..
S. District.	St. Saviour, Southwark ..	27,177	3	..	..	..	..	..	..	..	..	..	..	..	..	..
	St. George, Southwark ..	59,712	..	..	..	..	..	..	..	..	..	..	..	..	1	..
	Newington	115,804	1	..	1	..	..	..	1	..	..	..	..	1	..	..
	St. Olave, Southwark ..	12,723	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Bermondsey	84,682	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Rotherhithe	39,255	1	..	..	..	4	..	..	..	..	..	..	..	1	..
	Lambeth	275,203	2	..	1	..	1	..	1	..	1	..	1	..	2	..
	Battersea	150,558	2	..	4	1	1	..	2	..	2	1	2	..	..	..
	Wandsworth..	156,942	..	1	2	..	..	..	1	..	1	..	1	..	1	..
	Camberwell	235,344	9	..	3	..	3	..	2	1	5	..	5	..	2	..
	Greenwich	165,413	3	..	1	..	2	..	1	..	2	..	5	..	..	..
	Lewisham	92,647	..	..	2	..	..	..	..	..	..	..	..	..	..	..
	Woolwich	40,848	..	..	3	..	..	..	1	..	3	..	1	..	..	..
	Plumstead	52,436	1	..	2	..	1	..	2	..	..	..	..	..	..	..
	Lee	36,103														
	Port of London	..	..	..	..	..	1	..	..	..	..	..	2	..	..	..

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* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

SMALL-POX—*continued.*

Weekly Statement, 4th Quarters, 1893-97—*continued.*¶ 47th week, Nov. 27.		48th week, Dec. 4.		49th week, Dec. 11.		50th week, Dec. 18.		51st week, Dec. 25.		52nd week, Jan. 1, 1898.		53rd week —1 year only— in 1896.		Totals for 4th Quarters, 1893-97.		Grand Totals for Years, 1893-97.		Sanitary Areas.
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
29	3	41	1	47	4	47	3	28	2	28	2	1	..	575	34	5,792	355	London. (*Administrative County.*)
5	1	9	..	8	2	1	1	3	..	1	..	..	..	79	5	153	10	Kensington.
..	..	1	..	..	..	..	..	..	..	..	..	..	..	11	1	83	5	Fulham.
1	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	42	4	Hammersmith.
2	..	5	..	2	..	5	..	3	..	2	..	..	..	41	1	123	8	Paddington.
1	..	1	..	..	..	2	..	..	..	2	..	..	..	16	2	68	2	Chelsea.
..	..	1	..	..	..	..	..	..	..	..	..	..	..	4	1	42	5	St. George, Hanover Sq.*
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	58	..	Westminster.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	68	2	St. James, Westminster.
2	..	4	..	12	..	5	..	1	1	1	1	..	..	47	3	726	43	St. Marylebone.
..	..	2	..	..	..	..	..	..	..	..	..	..	..	2	..	40	5	Hampstead.
2	..	2	..	1	..	4	1	2	1	..	..	..	..	24	2	259	19	St. Pancras.
..	..	..	..	1	..	5	..	2	..	3	..	..	..	15	..	323	8	Islington.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	3	..	135	6	St. Mary, Stoke Newington. Hackney.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	104	7	St. Giles and St. George, Bloomsbury.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	18	4	St. Martin-in-the-Fields.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	51	5	Strand.†
..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	88	2	Holborn.‡
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	48	1	Clerkenwell.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	39	2	St. Luke, Middlesex,
..	..	..	..	..	..	..	..	..	..	..	..	..	..	3	..	40	4	London, City of.§
1	..	..	..	..	..	1	..	..	..	..	..	..	..	7	..	84	9	Shoreditch.
..	..	..	..	2	..	..	..	..	..	..	..	..	..	25	2	303	16	Bethnal Green,
1	..	..	..	2	..	1	..	..	..	..	..	..	..	8	..	228	9	Whitechapel.‖
..	..	..	..	1	..	..	..	..	..	..	..	..	..	4	..	80	1	St. George-in-the-East.
2	..	2	..	1	..	..	..	..	..	..	..	..	..	20	2	124	10	Limehouse.
2	..	1	..	..	..	1	..	1	..	4	..	..	..	14	1	227	13	Mile End Old Town.
3	2	7	..	5	1	5	..	4	..	..	..	..	..	74	5	398	23	Poplar.
..	..	..	..	..	..	..	..	..	..	1	..	..	..	4	..	30	..	St. Saviour, Southwark.
2	..	..	..	..	..	1	..	..	..	2	..	..	..	6	..	147	8	St. George, Southwark.
..	..	..	..	4	..	2	1	..	..	3	..	..	..	12	2	121	13	Newington.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	14	1	St. Olave, Southwark.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	78	5	Bermondsey.
1	..	..	..	..	..	2	..	..	..	1	..	..	..	10	..	155	14	Rotherhithe.
1	..	..	..	1	..	1	..	..	..	1	..	..	..	13	..	220	10	Lambeth.
..	..	..	..	..	..	1	..	..	..	..	..	..	..	14	2	175	15	Battersea.
1	..	1	..	..	..	..	..	..	..	..	..	1	..	9	1	59	3	Wandsworth.
1	..	..	1	..	..	..	..	..	..	..	..	..	..	30	2	291	25	Camberwell.
1	..	5	..	3	1	6	..	11	..	3	1	..	..	43	2	273	20	Greenwich.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	37	5	Lewisham.
..	..	..	..	1	..	1	..	..	..	3	..	..	..	12	..	85	5	Woolwich.
..	..	..	..	2	..	2	..	1	..	1	..	..	..	12	..	119	8	Plumstead. Lee.
..	..	..	..	1	..	1	..	..	..	..	..	..	..	5	..	36	..	Port of London.

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§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

¶ The actual dates of the registration weeks in 1897 have been given as perhaps aiding the reader.

	Sanitary Areas.	Population (1891).	SCARLET FEVER.											
			Weekly Statement, 1st Quarters, 1893–97.¶											
			1st week, Jan. 9.		2nd week, Jan. 16.		3rd week, Jan. 23.		4th week, Jan. 30.		5th week, Feb. 6.		6th week, Feb. 13.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
	London .. .. (*Administrative County.*)	4,232,118	1,925	129	1,761	110	1,956	93	1,918	90	1,795	97	1,838	92
W. District.	Kensington	166,308	77	4	48	4	65	4	68	2	44	6	94	1
	Fulham	91,639	34	6	51	..	57	4	50	1	43	4	39	3
	Hammersmith	97,239	38	3	44	3	43	2	45	6	33	2	42	1
	Paddington	117,846	50	5	38	3	39	3	47	4	46	1	53	1
	Chelsea	96,253	36	3	18	3	33	4	27	1	36	1	33	2
	St. George, Hanover Sq.* ..	78,599	27	1	14	2	18	1	28	1	36	1	31	1
	Westminster	55,539	21	..	22	2	12	..	21	3	20	1	6	1
	St. James, Westminster ..	24,995	12	..	4	2	10	..	4	1	11	..	5	2
N. District.	St. Marylebone	142,404	44	2	43	3	49	1	44	1	44	2	48	2
	Hampstead	68,416	38	1	21	..	28	..	25	1	33	..	22	1
	St. Pancras	234,379	99	9	75	2	95	9	127	5	97	5	75	4
	Islington	319,143	132	11	147	5	154	7	136	6	136	7	127	8
	St. Mary, Stoke Newington	30,936	129	5	115	3	147	9	146	5	110	5	137	5
	Hackney	198,606												
Central District.	St. Giles and St. George, Bloomsbury.	39,782	12	..	11	..	19	1	16	..	19	1	11	1
	St. Martin-in-the-Fields ..	14,616	3	..	4	..	6	..	3	..	6	..	3	1
	Strand†	25,217	6	1	7	..	10	1	6	2	6	1	3	..
	Holborn‡	34,043	14	1	15	..	20	..	13	1	16	2	12	1
	Clerkenwell	66,216	26	2	24	2	33	1	40	2	33	..	26	1
	St. Luke, Middlesex ..	42,440	18	2	19	4	25	3	12	3	22	2	15	1
	London, City of§	37,583	6	2	11	1	16	2	14	1	9	1	15	1
E. District	Shoreditch	124,009	53	4	58	5	51	2	44	2	44	3	59	5
	Bethnal Green	129,132	59	2	66	7	57	2	57	1	63	5	40	3
	Whitechapel‖	74,420	51	10	35	2	32	1	42	2	38	2	30	..
	St. George-in-the-East ..	45,795	26	1	25	2	23	3	28	2	24	2	18	..
	Limehouse	57,376	37	..	22	1	38	2	53	1	29	1	37	3
	Mile End Old Town ..	107,592	53	4	60	3	89	1	66	2	55	2	61	1
	Poplar	166,748	118	10	92	10	108	1	110	6	80	6	82	9
S. District.	St. Saviour, Southwark ..	27,177	10	..	11	..	7	..	11	..	9	..	5	..
	St. George, Southwark ..	59,712	19	3	20	2	9	1	14	3	22	..	26	..
	Newington	115,804	37	2	49	5	69	3	49	1	37	..	53	2
	St. Olave, Southwark ..	12,723	..	..	4	1	11	..	10	1	6	1	4	..
	Bermondsey	84,682	46	3	22	6	31	2	51	1	25	..	32	1
	Rotherhithe	39,255	24	2	23	1	18	..	20	..	26	..	18	2
	Lambeth	275,203	116	6	103	2	96	8	87	7	107	6	130	7
	Battersea	150,558	97	4	71	4	87	3	71	1	93	6	126	3
	Wandsworth	156,942	83	3	77	4	80	4	63	3	63	3	64	3
	Camberwell	235,344	109	4	108	5	108	5	103	6	79	10	61	8
	Greenwich	165,413	66	6	99	5	83	5	82	2	87	3	100	3
	Lewisham	92,647	21	2	28	1	33	2	26	2	41	..	30	1
	Woolwich	40,848	18	1	5	3	6	..	17	..	20	2	8	..
	Plumstead	52,436	58	4	50	2	35	1	42	1	47	3	56	3
	Lee	36,103												
	Port of London	..	..	..	2	..	1	..	..	..	..	..	1	..

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* Including St. Peter's, Westminster, (population, 235). † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

SCARLET FEVER—*continued.*

Weekly Statement, 1st Quarters, 1893-97—*continued.*¶

7th week, Feb. 20.		8th week, Feb. 27.		9th week, Mar. 6.		10th week, Mar. 13.		11th week, Mar. 20.		12th week, Mar. 27.		13th week, April 3.		Totals for 1st Quarters, 1893–97.		Sanitary Areas.
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
1,759	102	1,492	71	1,538	76	1,529	65	1,528	81	1,695	74	1,603	92	22,337	1,177	London. (*Administrative County*)
58	2	56	2	46	5	37	1	48	3	60	2	45	3	746	39	Kensington.
23	5	29	2	37	3	39	1	33	4	31	2	62	3	528	38	Fulham.
30	3	23	2	27	..	23	3	25	2	31	2	20	1	424	29	Hammersmith.
43	3	39	1	35	..	24	..	30	2	31	1	24	1	499	25	Paddington.
24	2	37	1	30	1	45	2	26	1	31	2	31	..	407	23	Chelsea.
22	..	15	..	17	1	16	..	26	1	32	..	24	1	306	10	St. George, Hanover Sq.*
16	.	13	..	18	1	8	..	19	2	17	..	12	2	205	12	Westminster.
9	1	12	..	4	..	5	..	6	..	10	..	3	..	95	6	St. James, Westminster.
37	4	35	3	38	4	45	3	40	6	48	1	54	3	569	35	St. Marylebone.
27	..	31	..	16	1	24	..	25	1	27	..	24	1	341	6	Hampstead.
102	4	89	4	96	3	86	7	85	4	102	5	74	5	1,202	66	St. Pancras.
197	3	137	7	128	6	149	7	120	6	134	10	132	5	1,829	88	Islington.
113	6	94	3	100	5	100	4	96	3	98	2	96	2	1,481	57	St. Mary, Stoke Newington. Hackney.
16	2	8	1	5	..	10	..	7	..	10	..	9	..	153	6	St. Giles and St. George, Bloomsbury.
1	..	2	..	..	..	4	..	2	..	2	..	2	..	38	1	St. Martin-in-the-Fields.
9	2	6	..	5	..	6	2	6	..	12	..	11	2	93	11	Strand.†
8	..	8	..	15	..	14	..	11	..	11	..	10	..	167	5	Holborn.‡
20	1	14	1	24	2	27	..	16	..	20	1	21	..	329	13	Clerkenwell.
12	..	16	1	10	1	11	..	8	2	7	1	6	..	181	20	St. Luke, Middlesex.
8	1	14	1	12	1	12	1	9	..	5	1	11	1	142	14	London, City of.§
50	8	34	2	41	4	43	2	33	3	36	2	32	1	578	43	Shoreditch.
51	1	31	..	35	3	53	1	48	6	67	1	46	3	673	35	Bethnal Green.
41	..	23	1	28	2	30	1	24	1	15	..	28	2	417	24	Whitechapel.‖
15	2	15	1	27	..	15	2	22	1	18	2	17	1	273	19	St. George-in-the-East.
49	1	33	6	34	..	32	2	44	2	26	2	35	6	469	27	Limehouse.
58	7	44	4	59	1	46	1	56	3	63	3	53	5	763	37	Mile End Old Town.
61	3	68	2	60	3	58	2	91	4	78	3	74	5	1,060	64	Poplar.
7	4	4	..	10	..	8	..	12	3	8	..	16	1	118	8	St. Saviour, Southwark.
25	3	16	4	30	..	24	2	20	3	17	..	22	2	264	23	St. George, Southwark.
39	3	45	1	41	2	42	2	41	1	29	4	45	5	576	31	Newington.
7	1	6	1	4	..	2	1	2	..	7	..	6	..	69	6	St. Olave, Southwark.
28	5	22	2	24	2	22	..	35	2	23	1	28	2	391	27	Bermondsey.
16	1	35	..	18	1	12	..	22	1	15	1	16	..	263	9	Rotherhithe.
95	9	90	8	111	4	94	4	98	3	94	4	88	5	1,309	73	Lambeth.
106	2	67	3	64	6	79	5	85	2	92	4	76	6	1,114	49	Battersea.
60	4	54	2	61	1	74	2	69	1	84	2	74	4	906	36	Wandsworth.
90	3	66	3	71	5	87	4	82	5	105	5	84	5	1,153	68	Camberwell.
101	6	83	1	74	4	54	1	51	1	113	5	96	4	1,088	46	Greenwich.
23	..	21	1	29	2	22	..	15	1	24	1	20	1	333	14	Lewisham.
10	..	9	..	8	..	7	..	11	..	15	1	9	2	143	9	Woolwich.
52	1	45	..	42	2	39	2	29	1	46	3	68	2	609	25	Plumstead. Lee.
..	..	3	..	4	..	1	..	..	..	1	..	..	.	13	..	Port of London.

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‡ Including Inner Temple (population, 96).

‖ Including Tower of London (population, 868).

¶ The actual dates of the registration weeks in 1897 have been given as perhaps aiding the reader.

District	Sanitary Areas.	Population (1891).	SCARLET FEVER—*continued.* Weekly Statement, 2nd Quarters, 1893-97.¶ 14th week, April 10.		15th week, April 17.		16th week, April 24.		17th week, May 1st.		18th week, May 8.		19th week, May 15.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
	London.. .. .. .. (*Administrative County.*)	4,232,118	1,584	90	1,514	77	1,759	82	1,806	88	1,787	82	1,854	9
W. District.	Kensington	166,308	40	2	33	1	56	2	46	4	58	..	39	4
	Fulham	91,639	47	2	35	3	39	3	42	1	37	6	42	..
	Hammersmith	97,239	31	..	20	1	28	1	31	2	29	..	45	1
	Paddington	117,846	32	2	45	1	45	1	37	2	46	1	27	1
	Chelsea	96,253	29	..	37	..	56	4	46	1	43	..	47	1
	St. George, Hanover Sq.*..	78,599	21	..	20	2	45	3	27	1	34	..	30	2
	Westminster	55,539	11	2	15	1	16	2	10	1	14	1	29	..
	St. James, Westminster ..	24,995	9	..	6	..	3	..	6	..	6	1	15	..
N. District.	St. Marylebone	142,404	54	2	39	4	57	4	63	7	56	4	55	2
	Hampstead	68,416	21	2	23	1	32	1	34	3	26	..	22	2
	St. Pancras	234,379	91	3	87	5	84	2	108	5	89	4	82	5
	Islington	319,143	135	3	126	8	128	7	114	6	135	6	159	6
	St. Mary, Stoke Newington	30,936	91	8	123	4	110	7	118	4	107	9	138	6
	Hackney	198,606												
Central District.	St. Giles and St. George, Bloomsbury.	39,782	8	2	8	1	5	..	11	1	10	..	14	2
	St. Martin-in-the-Fields..	14,616	4	..	5	..	3	..	..	..	8	..	2	..
	Strand†	25,217	7	..	4	..	5	1	8	1	6	..	5	..
	Holborn‡	34,043	10	..	9	..	11	1	17	..	13	..	8	..
	Clerkenwell	66,216	27	2	23	..	27	3	31	..	30	..	25	1
	St. Luke, Middlesex ..	42,440	13	1	6	..	14	1	12	..	12	1	12	1
	London, City of§	37,583	12	..	7	1	10	..	11	1	19	2	13	..
E. District.	Shoreditch	124,009	41	2	44	5	51	3	46	2	41	2	43	2
	Bethnal Green	129,132	35	7	43	2	38	5	50	2	66	1	56	4
	Whitechapel‖	74,420	33	2	30	..	33	1	29	1	42	2	46	..
	St. George-in-the-East ..	45,795	22	..	20	..	27	..	24	1	28	..	28	2
	Limehouse	57,376	32	3	25	2	30	2	28	2	31	2	27	1
	Mile End Old Town ..	107,592	44	4	48	..	53	4	50	2	35	4	45	2
	Poplar	166,748	74	5	71	5	79	1	94	1	87	5	71	3
S. District.	St. Saviour, Southwark ..	27,177	5	1	2	..	13	1	7	2	6	..	8	..
	St. George, Southwark ..	59,712	22	2	20	1	22	2	16	..	36	1	39	1
	Newington	115,804	31	4	45	5	55	2	52	3	50	1	55	1
	St. Olave, Southwark ..	12,723	4	..	4	..	6	..	6	1	1	2	..	..
	Bermondsey	84,682	27	1	28	3	32	1	26	1	37	6	33	3
	Rotherhithe	39,255	26	1	15	1	17	2	24	1	18	..	38	2
	Lambeth	275,203	101	8	76	4	102	3	111	6	91	4	98	4
	Battersea	150,558	80	5	73	3	91	..	113	3	107	3	87	2
	Wandsworth..	156,942	69	1	59	2	68	3	72	3	86	3	100	3
	Camberwell	235,344	83	1	86	4	92	3	120	3	81	2	97	6
	Greenwich	165,413	88	7	64	3	77	3	86	4	63	3	74	3
	Lewisham	92,647	20	1	21	..	34	..	25	1	36	2	25	2
	Woolwich	40,848	9	1	8	2	9	1	9	2	22	2	16	1
	Plumstead	52,436	44	3	59	2	53	2	44	7	53	2	58	3
	Lee	36,103												
	Port of London	..	1	..	2	..	5	..	2	..	2	..	1	..

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* Including St. Peter's, Westminster (population, 235).

† Including Middle Temple (population, 95).

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

SCARLET FEVER—*continued.*

Weekly Statement, 2nd Quarters, 1893–97—*continued.*¶

20th week, May 22.		21st week, May 29.		22nd week, June 5.		23rd week, June 12.		24th week, June 19.		25th week, June 26.		26th week, July 3.		Totals for 2nd Quarters, 1893–97.		Sanitary Areas.
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
2,069	83	2,021	80	2,142	92	2,261	85	2,317	101	2,453	90	2,641	100	26,211	1,129	London. (*Administrative County.*)
41	6	59	1	70	2	56	3	81	..	54	3	83	2	716	30	Kensington.
52	1	54	1	53	3	58	2	53	2	75	3	43	3	630	30	Fulham.
47	1	44	..	32	2	41	4	58	1	42	1	55	1	503	15	Hammersmith.
44	3	41	2	51	1	75	..	56	2	68	2	79	3	646	21	Paddington.
55	2	41	1	54	2	49	1	56	5	49	4	42	3	604	24	Chelsea.
28	..	30	2	32	3	39	3	30	3	30	1	46	1	412	21	St. George, Hanover Sq.*
18	2	16	1	27	2	18	..	17	1	23	3	30	..	244	16	Westminster.
1	1	10	..	10	1	11	..	10	..	5	..	11	..	103	3	St. James, Westminster.
71	1	62	3	66	1	57	2	79	3	80	4	69	2	808	39	St. Marylebone.
26	1	43	2	37	1	39	1	28	1	40	1	42	..	413	16	Hampstead.
118	4	95	2	119	5	129	6	131	4	152	3	139	6	1,424	54	St. Pancras.
148	5	181	7	172	9	174	2	162	3	200	7	222	7	2,054	76	Islington.
140	3	114	5	148	2	144	3	107	9	159	1	158	7	1,657	68	St.Mary,StokeNewington. Hackney.
6	..	19	..	14	..	14	2	10	1	15	..	21	1	155	10	St. Giles and St. George, Bloomsbury.
3	..	4	..	16	..	5	1	11	..	5	..	7	..	73	1	St. Martin-in-the-Fields.
7	1	7	..	13	..	11	..	8	2	5	..	11	1	97	6	Strand.†
8	..	14	..	13	..	16	..	17	1	14	..	14	..	164	2	Holborn.‡
26	..	38	1	43	2	38	1	75	.	63	2	36	6	482	18	Clerkenwell.
12	..	20	..	18	..	26	3	12	..	22	..	41	..	220	7	St. Luke, Middlesex.
23	..	17	1	13	1	23	..	16	1	11	1	47	..	222	8	London, City of.§
58	3	62	1	51	2	62	4	44	1	51	3	59	2	653	32	Shoreditch.
77	4	81	1	63	4	105	4	66	8	91	4	110	4	881	50	Bethnal Green.
50	..	22	1	42	4	46	2	60	2	72	2	52	2	557	19	Whitechapel.‖
27	..	32	1	36	3	36	3	35	..	27	2	36	2	378	14	St. George-in-the-East.
31	4	28	8	27	2	29	1	47	2	30	2	50	6	415	37	Limehouse.
61	3	60	..	78	5	80	5	89	2	71	2	81	2	795	35	Mile End Old Town.
93	3	108	1	110	5	87	4	112	5	112	4	82	7	1,180	49	Poplar.
11	1	12	1	9	..	17	1	19	2	24	1	22	1	155	11	St. Saviour, Southwark.
37	..	27	1	30	..	42	4	41	5	43	3	41	2	406	22	St. George, Southwark.
43	4	41	3	53	1	51	1	53	3	68	1	66	3	663	32	Newington.
5	..	4	..	13	..	3	..	5	..	6	..	4	1	61	4	St. Olave, Southwark.
54	4	35	3	35	2	38	1	49	1	42	5	46	2	482	33	Bermondsey.
31	2	19	1	17	3	22	2	19	1	21	1	22	1	289	18	Rotherhithe.
120	4	112	7	131	7	136	2	131	4	151	4	144	6	1,504	63	Lambeth.
91	2	98	3	94	3	120	7	92	4	101	4	120	1	1,267	40	Battersea.
93	2	80	3	80	7	73	2	109	2	80	1	107	1	1,076	33	Wandsworth.
110	3	110	6	89	3	105	1	109	7	121	4	129	4	1,332	47	Camberwell.
96	9	86	5	76	1	88	3	123	7	109	7	124	5	1,154	60	Greenwich.
30	1	28	..	28	..	29	..	23	1	31	1	50	2	370	11	Lewisham.
20	1	19	2	30	1	29	1	29	3	36	1	20	2	256	20	Woolwich.
66	2	50	3	48	2	39	3	45	2	54	2	80	1	693	34	Plumstead. Lee.
1	..	1	..	1	..	1	..	..	..	..	..	..	..	17	..	Port of London.

§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).
¶ The actual dates of the registration weeks in 1897 have been given as perhaps aiding the reader.

	Sanitary Areas.	Population (1891).	SCARLET FEVER—*continued.*											
			Weekly Statement, 3rd Quarters, 1893–97.¶											
			27th week, July 10.		28th week, July 17.		29th week, July 24.		30th week, July 31.		31st week, Aug. 7.		32nd week, Aug. 14.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
	London (*Administrative County.*)	4,232,118	2,841	97	3,033	94	3,113	122	3,066	114	3,081	122	2,694	91
W. District.	Kensington	166,308	90	1	94	4	97	2	79	3	75	2	83	2
	Fulham	91,639	36	3	61	1	96	2	78	3	68	3	65	1
	Hammersmith	97,239	58	1	52	2	70	1	54	3	56	5	35	2
	Paddington	117,846	74	4	96	6	96	3	84	4	81	..	60	1
	Chelsea	96,253	57	1	64	3	82	5	70	4	60	2	74	6
	St. George, Hanover Sq.*	78,599	54	3	37	1	57	2	57	1	43	2	34	1
	Westminster	55,539	21	1	31	1	41	2	34	8	31	..	26	1
	St. James, Westminster	24,995	12	..	16	1	7	..	13	..	14	1	16	..
N. District.	St. Marylebone	142,404	83	1	85	2	94	5	91	4	99	5	60	4
	Hampstead	68,416	30	..	55	1	42	3	36	..	25	1	23	2
	St. Pancras	234,379	148	2	203	3	185	7	236	8	236	10	173	6
	Islington	319,143	224	4	226	5	232	7	223	10	241	9	223	6
	St. Mary, Stoke Newington	30,936	153	9	178	6	161	5	169	8	181	5	151	5
	Hackney	198,606												
Central District.	St. Giles and St. George, Bloomsbury.	39,782	18	1	24	2	32	3	23	..	19	1	16	..
	St. Martin-in-the-Fields	14,616	8	..	12	..	4	2	7	..	6	2	1	..
	Strand†	25,217	13	..	22	..	29	1	13	..	19	1	13	1
	Holborn‡	34,043	29	1	25	2	18	1	19	..	26	..	21	1
	Clerkenwell	66,216	52	6	77	2	46	1	58	2	50	1	59	2
	St. Luke, Middlesex	42,440	21	2	24	..	34	2	33	6	40	7	28	1
	London, City of§	37,583	31	1	23	..	20	1	21	..	22	..	9	1
E. District.	Shoreditch	124,009	80	4	98	4	96	5	78	2	75	5	86	5
	Bethnal Green	129,132	110	3	108	3	111	2	81	3	126	4	125	2
	Whitechapel‖	74,420	78	2	76	3	90	2	111	1	94	2	96	2
	St. George-in-the-East	45,795	43	1	21	1	54	4	43	3	49	4	34	1
	Limehouse	57,376	50	1	54	1	51	2	51	4	56	2	59	1
	Mile End Old Town	107,592	86	1	123	4	105	5	91	3	131	4	104	5
	Poplar	166,748	133	8	126	6	112	7	124	4	109	5	114	4
S. District.	St. Saviour, Southwark	27,177	19	..	27	2	12	2	16	2	16	3	18	..
	St. George, Southwark	59,712	54	3	52	1	39	5	58	..	44	2	49	4
	Newington	115,804	107	4	66	4	88	1	100	1	94	3	62	2
	St. Olave, Southwark	12,723	9	..	13	..	3	..	6	..	8	..	8	1
	Bermondsey	84,682	56	1	39	3	51	1	57	1	46	6	45	2
	Rotherhithe	39,255	27	2	13	1	19	2	35	1	31	..	23	1
	Lambeth	275,203	188	9	178	3	211	9	203	4	201	4	161	3
	Battersea	150,558	122	6	91	2	106	3	137	1	130	6	108	3
	Wandsworth	156,942	102	2	131	2	111	2	81	2	99	3	91	..
	Camberwell	235,344	82	2	134	4	136	4	123	5	136	4	121	6
	Greenwich	165,413	120	4	126	6	130	4	120	7	82	2	124	2
	Lewisham	92,647	46	..	58	..	35	1	45	1	38	1	30	..
	Woolwich	40,848	30	2	34	1	34	4	38	1	47	4	21	1
	Plumstead	52,436	87	1	59	1	76	2	70	4	76	1	54	3
	Lee	36,103												
	Port of London	..	..	..	1	..	..	..	..	..	1	..	1	..

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* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 263), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

SCARLET FEVER—*continued.*																
Weekly Statement, 3rd Quarters, 1893-97—*continued.*¶														Totals for 3rd Quarters, 1893-97.		Sanitary Areas.
33rd week, Aug. 21.		34th week, Aug. 28.		35th week, Sept. 4.		36th week, Sept. 11.		37th week, Sept. 18.		38th week, Sept. 25.		39th week, Oct. 2.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
2,577	125	2,664	106	2,713	91	3,196	95	3,478	103	3,699	91	3,715	119	39,870	1,370	London. (*Administrative County.*)
58	1	60	5	94	3	74	2	96	4	109	4	124	5	1,133	38	Kensington.
48	1	47	..	83	3	67	3	65	4	80	..	77	3	871	27	Fulham.
54	3	48	4	55	..	47	3	38	..	82	2	64	4	713	30	Hammersmith.
44	1	43	3	61	2	60	2	63	3	90	..	64	2	916	31	Paddington.
38	4	43	2	43	2	52	..	45	1	63	1	89	4	780	35	Chelsea.
30	2	34	1	25	1	25	..	62	2	40	..	48	3	546	19	St. George, Hanover Sq.*
20	1	26	2	30	..	35	..	41	3	33	..	26	..	395	19	Westminster.
7	..	13	..	7	..	16	..	14	..	14	1	13	..	162	3	St. James, Westminster.
84	1	60	2	64	4	97	5	99	5	103	1	87	3	1,106	42	St. Marylebone.
15	2	35	1	12	1	29	..	38	..	41	1	41	1	422	13	Hampstead.
207	7	153	8	155	6	229	8	229	6	236	6	203	5	2,593	82	St. Pancras.
206	9	233	9	232	4	245	7	306	8	333	5	344	9	3,268	92	Islington.
157	2	210	3	189	..	218	6	264	4	199	6	226	11	2,446	70	St. Mary, Stoke Newington. Hackney.
17	1	27	..	19	..	26	1	22	..	24	..	26	..	293	9	St. Giles and St. George, Bloomsbury.
5	1	1	..	10	..	4	..	4	..	9	..	7	..	78	5	St. Martin-in-the-Fields.
14	4	14	1	19	3	20	1	27	..	19	1	18	2	240	15	Strand.†
24	..	19	..	12	..	33	..	27	..	21	1	19	..	293	6	Holborn.‡
34	..	47	3	41	1	60	2	90	2	57	..	71	1	742	23	Clerkenwell.
23	4	30	1	24	2	36	1	40	1	40	1	45	1	418	29	St. Luke, Middlesex.
15	1	13	2	27	..	26	..	29	1	27	1	32	..	295	8	London, City of.§
89	6	87	4	72	2	95	5	118	3	97	2	114	3	1,185	50	Shoreditch.
114	5	143	5	138	5	157	7	193	3	157	3	192	3	1,755	48	Bethnal Green.
85	7	82	5	109	..	105	3	106	1	97	4	106	4	1,225	36	Whitechapel.‖
27	3	44	2	34	3	55	3	60	1	59	2	51	2	574	30	St. George-in-the-East.
53	2	52	1	58	5	54	4	49	5	57	1	72	2	716	31	Limehouse.
82	3	102	4	111	1	119	2	131	1	126	1	120	5	1,431	39	Mile End Old Town.
115	9	107	4	140	10	151	2	166	6	182	9	191	11	1,770	85	Poplar.
9	..	23	..	10	..	19	1	23	1	13	..	19	1	224	12	St. Saviour, Southwark.
40	3	45	4	39	3	41	1	58	3	50	4	46	3	615	36	St. George, Southwark.
91	5	61	1	68	2	97	4	73	5	117	1	113	3	1,137	36	Newington.
3	..	8	..	4	..	6	..	2	..	5	..	8	..	83	1	St. Olave, Southwark.
47	1	49	..	48	2	55	..	66	2	54	5	49	3	662	27	Bermondsey.
20	1	44	..	21	3	31	2	29	4	36	2	43	2	372	21	Rotherhithe.
165	4	141	4	143	2	184	4	214	6	228	5	242	6	2,459	63	Lambeth.
111	6	118	2	121	3	129	2	121	8	206	3	170	3	1,670	48	Battersea.
90	2	75	3	70	3	99	1	85	2	108	5	92	3	1,234	30	Wandsworth.
119	6	124	6	139	6	139	3	136	2	208	8	173	3	1,770	59	Camberwell.
95	8	79	6	99	4	129	7	153	4	149	2	132	3	1,538	59	Greenwich.
34	2	39	3	26	..	45	..	25	..	46	..	43	3	510	11	Lewisham.
23	3	20	3	9	..	22	1	25	..	12	..	30	..	345	20	Woolwich.
64	4	64	2	49	5	65	2	56	2	71	3	84	2	875	32	Plumstead. Lee.
1	..	1	..	3	..	..	..	..	..	1	..	1	..	10	..	Port of London.

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§ Including Inner Temple (population, 96).

‖ Including Tower of London (population, 868)

¶ The actual dates of the registration weeks in 1897 have been given as perhaps aiding the reader.

	Sanitary Areas.	Population (1891).	SCARLET FEVER—*continued.*													
			Weekly Statement, 4th Quarters, 1893-97.¶													
			40th week, Oct. 9.		41st week, Oct. 16.		42nd week, Oct. 23.		43rd week, Oct. 30.		44th week, Nov. 6.		45th week, Nov. 13.		46th week. Nov. 20.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
	London .. .. (*Administrative County.*)	4,232,118	3,757	117	3,912	113	3,827	112	3,603	106	3,437	107	3,276	113	3,022	107
W. District.	Kensington	166,308	106	4	133	6	119	4	112	5	89	4	120	5	74	9
	Fulham	91,639	95	2	103	1	72	4	82	3	93	4	80	1	93	1
	Hammersmith	97,239	84	3	65	3	55	2	62	..	64	1	53	..	56	1
	Paddington	117,846	73	3	81	3	89	2	74	..	68	3	60	4	75	1
	Chelsea..	96,253	76	4	68	3	68	1	76	2	54	4	86	1	69	..
	St. George, Hanover Sq.*..	78,599	42	2	74	1	60	2	49	1	50	..	26	..	47	..
	Westminster	55,539	33	..	42	3	30	2	30	1	31	1	31	..	23	1
	St. James, Westminster ..	24,995	13	..	3	..	25	1	5	2	10	1	5	1	9	..
N. District.	St. Marylebone	142,404	111	3	108	3	89	5	82	4	86	2	54	3	63	3
	Hampstead	68,416	38	..	56	2	45	1	48	1	50	..	28	2	42	..
	St. Pancras	234,379	189	2	203	4	206	4	186	5	191	2	185	11	175	4
	Islington	319,143	315	8	290	7	328	6	286	5	276	11	244	5	231	9
	St. Mary, Stoke Newington	30,936	255	6	244	6	260	6	256	4	254	3	237	8	240	3
	Hackney	198,606														
Central District.	St. Giles and St. George, Bloomsbury.	39,782	39	1	45	1	27	1	23	..	17	1	24	..	32	1
	St. Martin-in-the-Fields..	14,616	8	..	11	..	6	..	8	1	6	..	5	..	9	..
	Strand†..	25,217	16	..	22	1	19	1	12	..	10	1	9	1	13	..
	Holborn‡	34,043	31	..	28	.	18	..	16	2	15	..	31	1	8	1
	Clerkenwell	66,216	63	2	72	4	79	3	47	2	53	4	53	5	65	1
	St. Luke, Middlesex ..	42,440	24	1	48	2	30	..	45	..	33	1	25	3	26	3
	London, City of§	37,583	19	..	40	..	38	1	28	..	24	..	24	2	17	..
E. District	Shoreditch	124,009	117	6	99	5	91	..	113	4	96	5	73	1	91	2
	Bethnal Green	129,132	150	6	149	2	142	6	176	8	148	6	154	3	117	4
	Whitechapel‖	74,420	71	1	75	3	71	4	74	1	67	3	58	3	70	3
	St. George-in the-East ..	45,795	59	..	62	4	55	2	34	5	39	..	35	3	30	1
	Limehouse	57,376	91	1	89	2	60	1	72	3	71	3	56	4	44	..
	Mile End Old Town ..	107,592	141	5	102	5	122	4	96	2	91	6	93	1	71	4
	Poplar	166,748	174	6	149	4	154	4	150	4	133	5	145	3	142	5
S. District.	St. Saviour. Southwark ..	27,177	17	1	25	..	19	1	13	..	22	2	19	..	23	2
	St. George, Southwark ..	59,712	44	1	51	..	63	1	66	2	51	3	59	5	22	3
	Newington	115,804	116	4	155	7	140	3	113	2	115	3	92	5	85	3
	St. Olave, Southwark ..	12,723	13	1	20	..	17	1	13	..	7	..	9	..	3	..
	Bermondsey..	84,682	56	4	65	2	61	2	68	3	68	..	79	..	38	5
	Rotherhithe	39,255	30	3	41	..	63	1	46	1	63	2	43	4	52	2
	Lambeth	275,203	250	11	274	6	294	9	247	9	246	7	221	7	205	5
	Battersea	150,558	211	4	161	4	174	3	167	4	164	2	185	3	148	2
	Wandsworth	156,942	98	5	136	4	155	3	126	3	133	1	114	5	130	6
	Camberwell	235,344	148	6	193	6	200	6	175	6	167	6	154	2	133	4
	Greenwich	165,413	164	8	159	4	144	9	165	7	135	5	158	7	122	11
	Lewisham	92,647	69	..	54	1	46	1	50	1	54	2	43	..	37	2
	Woolwich	40,848	24	1	31	1	32	2	27	..	21	1	33	2	27	2
	Plumstead	52,436	84	3	86	3	61	3	86	3	72	2	73	2	64	3
	Lee	36,103														
	Port of London	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..

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* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121)

SCARLET FEVER—*continued.* Weekly Statement, 4th Quarters, 1893-97—*continued.*¶ 47th week, Nov. 27.		48th week, Dec. 4.		49th week, Dec. 11.		50th week, Dec. 18.		51st week, Dec. 25.		52nd week, Jan. 1, 1898.		53rd week—1 year only—in 1896.		Totals for 4th Quarters, 1893-97.		Grand Totals for Years, 1893-97.		Sanitary Areas.
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
2,739	128	2,554	110	2,508	111	2,273	96	1,971	99	1,801	81	451	19	39,131	1,419	127,549	5,095	London. (*Administrative County.*)
81	4	89	3	73	6	81	5	51	3	65	6	15	1	1,208	65	3,803	172	Kensington.
75	11	62	5	73	6	60	4	48	3	52	2	14	..	1,002	47	3,031	142	Fulham.
53	5	45	1	64	4	46	2	28	..	33	2	18	1	726	25	2,366	99	Hammersmith.
65	2	59	2	58	2	49	1	40	1	39	1	17	2	847	27	2,908	104	Paddington.
73	5	65	3	47	..	47	2	44	3	37	3	3	..	813	31	2,604	113	Chelsea.
32	1	22	4	37	1	27	..	37	..	16	2	10	..	529	14	1,793	64	St. George, Hanover Sq.*
31	1	14	..	23	2	15	1	16	2	12	..	5	..	336	14	1,180	61	Westminster.
18	1	11	1	10	..	17	..	5	..	5	..	1	..	137	7	497	19	St. James, Westminster.
68	1	50	3	52	5	55	4	43	2	35	3	8	..	904	41	3,387	157	St. Marylebone.
31	2	37	2	34	..	33	2	26	4	24	..	5	..	497	16	1,673	51	Hampstead.
150	10	133	3	113	5	125	3	110	5	53	4	20	..	2,039	62	7,258	264	St. Pancras.
188	5	178	7	214	9	187	5	181	6	119	9	38	..	3,075	92	10,226	348	Islington.
187	4	187	7	172	4	149	4	120	7	118	5	36	..	2,715	67	8,299	262	St. Mary, Stoke Newington. Hackney.
19	2	22	1	15	..	11	2	12	..	17	1	3	..	306	11	907	36	St. Giles and St. George, Bloomsbury.
6	1	8	..	5	..	6	..	7	..	3	..	3	1	91	3	280	10	St. Martin-in-the-Fields.
7	..	5	1	11	1	6	..	8	..	5	..	2	..	145	6	575	38	Strand.†
12	2	25	..	7	2	7	..	9	1	12	..	..	..	219	9	843	22	Holborn.‡
47	1	35	2	33	5	32	..	27	2	30	..	7	1	643	32	2,196	86	Clerkenwell.
38	1	20	1	27	3	19	1	12	1	16	1	4	3	367	21	1,186	77	St. Luke, Middlesex.
14	..	16	..	13	1	14	..	5	..	9	..	1	2	262	6	921	36	London, City of.§
96	3	74	3	63	5	60	4	57	2	52	..	16	..	1,098	40	3,514	165	Shoreditch.
101	4	110	4	82	2	77	5	82	2	86	3	20	..	1,594	55	4,903	188	Bethnal Green.
36	1	44	..	53	7	42	3	27	4	47	..	9	1	744	34	2,943	113	Whitechapel.‖
38	..	44	2	37	3	33	..	21	..	31	1	3	..	521	21	1,746	84	St. George-in-the-East.
58	3	41	1	44	2	31	..	34	..	21	..	7	..	719	20	2,319	115	Limehouse.
78	1	73	..	63	1	71	4	72	2	54	3	12	..	1,138	38	4,127	149	Mile End Old Town.
122	4	107	2	124	4	120	6	104	7	108	2	19	..	1,751	56	5,781	254	Poplar.
14	1	14	..	20	2	8	..	9	1	4	1	1	..	208	11	705	42	St. Saviour, Southwark.
29	3	27	1	37	..	28	3	19	..	26	1	9	..	531	23	1,816	104	St. George, Southwark.
71	4	75	2	80	4	58	3	34	5	60	3	19	1	1,213	49	3,589	148	Newington.
13	..	12	..	6	1	8	1	8	..	4	2	2	..	135	6	348	17	St. Olave, Southwark.
47	4	51	4	32	5	22	2	31	2	38	3	6	..	662	36	2,197	123	Bermondsey.
28	1	35	3	32	1	29	1	15	3	21	1	2	..	500	23	1,424	71	Rotherhithe.
192	9	140	7	172	4	166	7	145	7	124	6	23	1	2,699	94	7,971	293	Lambeth.
131	7	126	5	125	1	111	1	112	5	108	3	18	..	1,941	44	5,992	181	Battersea.
118	2	118	7	83	2	96	3	95	5	75	1	14	1	1,491	48	4,707	147	Wandsworth.
158	9	128	8	139	5	114	6	93	3	80	7	20	1	1,902	75	6,157	249	Camberwell.
103	8	113	4	110	2	112	8	79	4	96	5	19	2	1,679	84	5,459	249	Greenwich.
33	..	40	3	39	..	35	..	43	1	20	..	7	1	570	12	1,783	48	Lewisham.
16	1	23	2	16	3	21	..	15	2	10	..	3	..	299	17	1,043	66	Woolwich.
62	4	76	6	70	1	45	3	47	4	36	..	12	..	874	37	3,051	128	Plumstead. Lee.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	41	..	Port of London.

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§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

¶ The actual dates of the registration weeks in 1897 have been given as perhaps aiding the reader.

Sanitary Areas.		Population (1891).	Diphtheria. Weekly Statement, 1st Quarters, 1893-97.¶ 1st week, Jan. 9.		2nd week, Jan. 16.		3rd week, Jan. 23.		4th week, Jan. 30.		5th week, Feb. 6.		6th week, Feb. 13.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
London .. .. (*Administrative County.*)		4,232,118	1,113	299	903	245	975	237	1,078	233	1,053	263	952	247
Kensington	W. District.	166,308	31	10	21	3	22	2	28	10	16	6	24	4
Fulham		91,639	34	16	29	6	26	7	21	7	29	7	31	10
Hammersmith		97,239	20	10	17	4	21	6	28	7	32	5	12	7
Paddington		117,846	18	10	18	5	28	6	27	4	33	7	22	6
Chelsea		96,253	12	3	24	5	30	8	28	4	24	11	29	9
St. George, Hanover Sq.* ..		78,599	10	1	7	5	13	2	11	1	13	1	10	3
Westminster		55,539	10	3	11	3	11	..	12	3	8	2	10	..
St. James, Westminster ..		24,995	1	..	3	..	4	3	1	..	3	..	4	..
St. Marylebone	N. District.	142,404	25	6	20	9	25	5	21	1	20	5	24	4
Hampstead		68,416	10	1	16	2	14	4	19	5	12	6	18	4
St. Pancras		234,379	52	10	64	15	41	10	51	12	62	12	49	13
Islington		319,143	108	20	71	18	93	22	88	26	61	23	81	15
St. Mary, Stoke Newington		30,936	63	20	57	14	62	13	73	17	67	17	43	15
Hackney		198,606												
St. Giles and St. George, Bloomsbury.	Central District.	39,782	10	3	6	2	3	1	3	1	5	..	5	..
St. Martin-in-the-Fields ..		14,616	1	1	2	1	2	..	..	..	..	..	1	..
Strand†		25,217	8	2	1	1	7	3	3	1	5	1	4	1
Holborn‡		34,043	6	1	8	2	6	3	11	2	5	1	8	..
Clerkenwell		66,216	15	5	15	2	11	7	17	5	5	..	15	3
St. Luke, Middlesex ..		42,440	9	2	15	5	4	2	9	..	7	4	13	1
London, City of §		37,583	10	..	5	1	5	..	3	..	8	..	5	..
Shoreditch	E. District.	124,009	27	9	22	7	26	4	41	8	32	13	20	7
Bethnal Green		129,132	51	11	33	15	29	13	45	11	37	8	45	9
Whitechapel ‖		74,420	25	9	8	4	16	2	24	4	29	3	15	1
St. George-in-the-East ..		45,795	21	6	22	8	24	4	11	2	21	7	24	5
Limehouse		57,376	15	3	12	7	20	3	18	2	16	4	17	6
Mile End Old Town ..		107,592	42	12	26	5	33	8	46	11	42	16	37	9
Poplar		166,748	70	15	41	15	45	8	43	11	50	7	41	10
St. Saviour, Southwark ..	S. District.	27,177	11	1	1	..	5	1	3	..	5	2	3	1
St. George, Southwark ..		59,712	5	2	5	3	8	1	8	3	11	..	8	..
Newington		115,804	17	7	23	8	28	6	30	8	32	7	31	7
St. Olave, Southwark ..		12,723	2	..	1	..	..	..	3	1	4	..	1	..
Bermondsey		84,682	19	4	23	8	12	9	6	4	19	3	11	8
Rotherhithe		39,255	10	2	12	2	7	3	13	3	17	3	6	3
Lambeth		275,203	86	16	54	13	63	19	37	10	49	12	53	17
Battersea		150,558	58	18	43	10	62	11	44	10	49	11	34	12
Wandsworth		156,942	35	10	22	5	23	3	24	4	22	8	36	6
Camberwell		235,344	63	17	52	4	68	13	100	12	87	21	77	11
Greenwich		165,413	41	13	41	13	26	9	68	9	68	17	55	18
Lewisham		92,647	20	4	15	3	19	2	15	2	17	5	20	7
Woolwich		40,848	11	4	4	2	11	3	13	2	4	1	7	5
Plumstead		52,436	30	12	27	10	22	11	32	10	27	7	13	10
Lee		36,103												
Port of London		..	1	..	..	..	..	..	..	..	..	..	..	..

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* Including St. Peter's, Westminster (population, 235).   † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

DIPHTHERIA—*continued.*

Weekly Statement, 1st Quarters, 1893-97—*continued.*¶														Totals for 1st Quarters, 1893-97.		Sanitary Areas.
7th week, Feb. 20.		8th week. Feb. 27.		9th week, Mar. 6.		10th week. Mar. 13.		11th week, Mar. 20.		12th week, Mar. 27.		13th week, April 3.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
981	224	994	228	953	217	902	221	997	225	1,007	219	878	213	12,786	3,071	London. (*Administrative County.*)
23	6	19	3	27	4	25	8	34	10	29	11	27	2	326	79	Kensington.
12	4	17	6	32	7	29	9	36	10	31	4	23	6	350	99	Fulham.
19	4	18	3	11	4	9	4	14	1	25	3	21	4	247	62	Hammersmith.
15	10	23	5	17	4	18	6	20	7	24	1	8	5	271	76	Paddington.
21	5	21	4	23	4	17	4	20	2	30	5	27	..	306	64	Chelsea.
8	1	9	5	3	1	7	2	8	2	16	1	6	3	121	28	St. George, Hanover Sq.*
9	1	9	..	10	2	11	2	15	1	12	6	14	3	142	26	Westminster.
4	2	1	..	4	1	6	1	2	1	6	1	8	3	47	12	St. James, Westminster.
21	5	32	5	23	8	20	5	21	8	18	6	18	3	288	70	St. Marylebone.
15	2	13	1	14	3	16	3	17	2	18	6	22	8	204	47	Hampstead.
46	18	53	17	47	12	39	14	57	10	63	9	41	16	665	168	St. Pancras.
80	16	75	20	57	20	51	10	75	13	52	12	67	13	959	228	Islington.
57	9	50	11	53	12	54	15	62	11	62	12	46	7	749	173	St. Mary, Stoke Newington. Hackney.
8	1	6	1	2	1	4	..	1	1	7	1	6	3	66	15	St. Giles and St. George, Bloomsbury.
2	..	..	..	..	..	4	..	5	3	2	3	..	1	19	9	St. Martin-in-the-Fields.
2	..	8	1	..	..	4	1	3	1	1	1	3	2	49	15	Strand.†
9	2	3	..	8	2	9	1	8	3	4	2	4	..	89	19	Holborn.‡
18	2	14	4	20	4	17	5	19	4	15	4	12	2	193	47	Clerkenwell.
4	2	9	2	8	2	6	..	10	1	8	1	3	2	105	24	St. Luke, Middlesex.
4	1	2	1	6	..	2	1	1	..	1	1	6	1	58	6	London, City of.§
34	5	25	10	38	7	25	7	32	10	39	12	23	10	384	109	Shoreditch.
43	12	42	11	54	13	34	20	30	13	30	6	32	7	508	149	Bethnal Green.
23	5	20	5	26	2	14	1	18	4	25	5	17	4	260	49	Whitechapel.‖
16	5	15	3	20	4	17	3	8	2	9	2	17	8	225	59	St. George-in-the-East.
15	3	10	3	19	5	19	4	14	3	8	2	19	5	202	50	Limehouse.
45	7	44	8	38	5	37	8	32	11	42	9	39	7	503	116	Mile End Old Town.
61	12	69	18	51	14	39	7	57	8	58	15	71	8	696	148	Poplar.
6	2	3	..	3	1	4	1	6	1	6	2	3	1	59	13	St. Saviour, Southwark.
7	1	13	4	13	4	8	2	8	1	8	2	10	5	112	28	St. George, Southwark.
29	6	24	7	17	4	35	2	23	5	20	4	25	2	334	73	Newington.
..	..	3	..	..	..	3	1	1	..	..	..	5	..	23	2	St. Olave, Southwark.
14	2	16	..	14	4	14	3	8	5	16	3	11	4	183	57	Bermondsey.
..	..	10	2	10	..	8	3	21	3	9	1	3	1	126	26	Rotherhithe.
54	11	61	18	43	9	52	8	36	17	47	13	31	5	666	168	Lambeth.
40	7	51	7	37	8	31	7	39	9	47	8	36	8	564	136	Battersea.
34	12	25	5	38	7	49	16	50	6	31	9	24	7	413	98	Wandsworth.
74	15	71	13	74	15	80	20	87	14	84	15	63	18	980	188	Camberwell.
57	17	66	9	65	17	52	9	51	12	64	13	55	17	709	173	Greenwich.
19	3	18	8	12	3	15	4	19	3	17	2	19	6	225	52	Lewisham.
11	..	7	2	6	2	4	2	8	2	5	1	3	1	94	27	Woolwich.
22	8	18	6	10	2	14	2	20	5	17	5	10	5	262	93	Plumstead. Lee.
..	..	1	..	..	..	..	..	1	..	1	..	..	..	4	..	Port of London.

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§ Including Inner Temple (population, 96).

‖ Including Tower of London (population, 868).

¶ The actual dates of the registration weeks in 1897 have been given as perhaps aiding the reader.

	Sanitary Areas.	Population (1891).	DIPHTHERIA—*continued.*											
			Weekly Statement, 2nd Quarters, 1893-97.¶											
			14th week, April 10.		15th week, April 17.		16th week, April 24.		17th week, May 1.		18th week, May 8.		19th week, May 15.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
	London .. .. (*Administrative County.*)	4,232,118	902	188	846	192	931	205	964	217	1,052	201	1,006	238
W. District	Kensington	166,308	19	1	17	5	28	9	36	5	23	4	27	6
	Fulham	91,639	24	5	24	1	21	3	18	6	16	2	24	8
	Hammersmith	97,239	8	5	9	5	16	1	18	6	18	2	19	6
	Paddington	117,846	28	5	31	5	27	5	22	11	33	0	19	7
	Chelsea	96,253	21	4	17	6	25	10	22	3	23	2	21	2
	St. George, Hanover Sq.* ..	78,599	7	4	4	3	11	2	12	..	11	4	7	3
	Westminster	55,539	4	2	6	..	5	..	9	4	8	3	7	1
	St. James, Westminster ..	24,995	2	1	1	1	5	1	12	..	7	..	1	..
N. District.	St. Marylebone	142,404	14	6	24	3	21	7	28	11	38	7	30	11
	Hampstead	68,416	11	3	6	1	10	1	11	1	14	4	15	2
	St. Pancras	234,379	49	15	24	11	49	5	48	13	48	6	35	9
	Islington	319,143	80	16	58	14	50	14	50	14	73	17	86	20
	St. Mary, Stoke Newington	30,936	42	7	55	8	64	14	42	8	62	15	75	15
	Hackney	198,606												
Central District.	St. Giles and St. George, Bloomsbury.	39,782	4	3	5	1	6	2	8	2	4	2	9	1
	St. Martin-in-the-Fields ..	14,616	..	..	1	..	..	..	2	..	2	1	4	1
	Strand†	25,217	7	2	2	2	6	..	4	2	4	2	3	..
	Holborn‡	34,043	7	..	2	2	7	1	7	3	7	1	5	1
	Clerkenwell	66,216	18	3	17	7	15	3	23	3	12	4	28	6
	St. Luke, Middlesex ..	42,440	8	1	6	1	10	4	11	2	8	1	7	3
	London, City of§	37,583	5	1	4	1	5	..	3	..	7	2	8	1
E. District.	Shoreditch	124,009	28	8	22	6	31	3	29	16	27	5	36	5
	Bethnal Green	129,132	44	5	43	6	43	5	48	5	43	6	45	16
	Whitechapel‖	74,420	23	2	31	7	19	3	19	2	28	2	19	5
	St. George-in-the-East ..	45,795	10	2	20	3	13	6	16	3	25	1	16	3
	Limehouse	57,376	22	6	11	2	24	6	18	3	26	6	13	5
	Mile End Old Town ..	107,592	28	10	41	2	34	9	33	5	39	8	44	11
	Poplar	166,748	65	8	60	13	51	12	85	13	73	18	77	13
S. District.	St. Saviour, Southwark ..	27,177	5	1	1	..	5	1	4	1	11	2	5	2
	St. George, Southwark ..	59,712	7	2	6	3	15	3	15	3	20	5	12	3
	Newington	115,804	20	3	22	6	30	8	27	4	21	4	15	5
	St. Olave, Southwark ..	12,723	1	..	2	1	1	1	4	..	2	..	1	..
	Bermondsey	84,682	23	6	19	9	23	10	10	4	24	2	20	7
	Rotherhithe	39,255	7	1	6	2	5	1	14	1	8	7	10	4
	Lambeth	275,203	41	8	47	8	50	11	47	12	62	10	58	18
	Battersea	150,558	32	6	31	10	41	9	43	9	50	8	30	9
	Wandsworth	156,942	21	5	15	2	19	3	22	6	22	6	29	7
	Camberwell	235,344	66	15	63	12	58	13	60	13	73	8	73	9
	Greenwich	165,413	63	6	45	10	52	9	46	14	37	7	41	5
	Lewisham	92,647	10	4	18	5	12	3	12	2	14	3	14	1
	Woolwich	40,848	7	1	6	1	2	1	9	3	4	2	5	1
	Plumstead	52,436	31	5	24	7	22	6	17	4	19	4	13	6
	Lee	36,103												
	Port of London	..	..	..	..	..	..	..	..	..	1	..	..	..

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* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

DIPHTHERIA—*continued.*

Weekly Statement, 2nd Quarters, 1893–97—*continued.*¶														Totals for 2nd Quarters, 1893–97.		Sanitary Areas.
20th week, May 22.		21st week. May 29.		22nd week, June 5.		23rd week, June 12.		24th week. June 19.		25th week, June 26.		26th week, July 3.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
1060	220	1,085	211	1,028	197	1,129	193	1,226	225	1,223	211	1,231	226	13,683	2,724	London. (*Administrative County.*)
26	6	20	7	35	13	36	6	21	5	21	3	35	8	347	78	Kensington.
27	4	24	8	31	5	22	7	33	13	27	6	37	9	328	77	Fulham.
17	1	18	5	16	1	15	2	12	2	30	1	29	8	225	45	Hammersmith.
38	5	35	5	44	6	28	9	20	9	30	3	29	6	384	85	Paddington.
33	6	37	12	20	3	28	2	25	6	23	5	30	8	325	69	Chelsea.
7	..	21	1	15	5	17	3	14	..	7	4	10	1	143	30	St. George, Hanover Sq.*
8	4	10	1	3	2	6	..	10	2	4	..	7	..	87	19	Westminster.
6	1	6	1	1	1	2	..	4	1	4	..	9	..	60	7	St. James, Westminster.
23	13	24	3	26	6	32	2	32	5	27	4	31	9	350	87	St. Marylebone.
16	2	21	3	12	6	4	2	16	2	10	..	10	3	156	30	Hampstead.
49	11	55	8	32	7	48	4	64	13	63	10	48	10	612	122	St. Pancras.
85	28	79	14	99	22	77	17	70	5	115	17	74	20	1,001	216	Islington.
61	15	59	7	39	8	60	15	57	5	54	3	61	13	731	133	St. Mary, Stoke Newington. Hackney.
5	1	10	1	7	..	7	1	5	2	7	..	9	3	86	19	St. Giles and St. George, Bloomsbury.
..	..	2	1	2	..	4	..	1	1	1	..	..	..	19	4	St. Martin-in-the-Fields.
3	..	6	3	6	..	8	..	4	1	3	..	6	2	62	14	Strand.†
5	..	14	4	19	4	16	1	6	1	16	1	13	4	124	23	Holborn.‡
21	5	24	2	21	4	20	5	24	6	15	4	17	2	255	54	Clerkenwell.
8	1	15	3	11	3	11	2	16	3	14	2	18	1	143	27	St. Luke, Middlesex.
4	2	4	..	3	..	4	..	13	..	7	3	4	..	71	10	London, City of.§
19	2	23	6	28	6	27	13	34	8	31	7	32	4	367	89	Shoreditch.
39	11	40	6	43	8	52	5	64	11	45	11	81	7	630	102	Bethnal Green.
33	6	29	6	19	3	30	4	18	5	22	2	24	6	314	53	Whitechapel.‖
26	2	30	5	36	6	28	9	29	11	33	5	8	3	290	59	St. George-in-the-East.
29	7	23	7	13	3	23	3	26	7	16	7	11	2	255	64	Limehouse.
44	9	40	9	40	4	41	4	50	11	49	12	45	4	528	98	Mile End Old Town.
72	10	57	7	51	9	76	8	110	15	108	18	85	13	970	157	Poplar.
3	2	9	..	3	2	8	1	12	..	5	1	9	2	80	15	St. Saviour, Southwark.
5	1	13	3	7	1	18	3	24	2	23	2	18	2	183	33	St. George, Southwark.
32	4	17	6	22	3	39	8	42	5	37	3	39	6	363	65	Newington.
..	..	2	..	2	1	1	..	2	..	2	..	2	..	22	3	St. Olave, Southwark.
19	5	19	4	27	10	26	9	18	5	30	9	39	9	297	89	Bermondsey.
17	3	13	7	12	2	16	2	15	4	10	2	21	4	154	40	Rotherhithe.
71	9	52	8	60	5	51	7	75	8	73	8	66	10	753	122	Lambeth.
39	8	52	13	31	10	38	5	49	7	61	14	47	7	544	115	Battersea.
27	4	30	4	27	5	32	4	24	5	21	8	35	7	324	66	Wandsworth.
63	16	64	14	78	11	95	15	90	16	71	18	109	21	963	181	Camberwell.
48	12	52	9	50	9	49	6	54	11	64	9	54	6	655	113	Greenwich.
13	3	19	4	16	..	11	3	17	5	15	4	14	2	185	38	Lewisham.
4	..	4	..	7	1	8	3	6	1	8	1	1	2	71	17	Woolwich.
15	3	13	4	13	2	14	3	17	6	21	4	14	2	223	56	Plumstead. Lee.
..	..	..	..	1	..	1	..	..	..	..	..	..	..	3	..	Port of London.

§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).
¶ The actual dates of the registration weeks in 1897 have been given as perhaps aiding the reader.

	Sanitary Areas.	Population (1891).	DIPHTHERIA—*continued.*											
			Weekly Statement, 3rd Quarters, 1893-97.¶											
			27th week, July 10.		28th week, July 17.		29th week, July 24.		30th week, July 31.		31st week, Aug. 7.		32nd week, Aug. 14.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
	London .. .. *(Administrative County.)*	4,232,118	1,335	235	1,401	225	1,350	234	1,398	260	1,366	262	1,241	270
W. District.	Kensington	166,308	23	7	52	9	53	10	55	9	50	12	33	9
	Fulham	91,039	30	5	30	10	32	1	25	7	29	4	31	7
	Hammersmith	97,239	25	4	39	6	18	6	30	3	21	5	18	3
	Paddington	117,846	43	6	44	5	35	10	35	5	36	6	32	9
	Chelsea..	96,253	35	7	39	2	36	7	48	8	40	12	38	6
	St. George, Hanover Sq.*..	78,599	12	..	17	1	18	1	12	4	16	4	13	2
	Westminster	55,539	15	3	8	..	14	2	8	1	7	2	12	2
	St. James, Westminster ..	24,995	6	1	4	2	3	..	6	1	4	..	10	1
N. District.	St. Marylebone	142,404	31	1	33	8	39	7	27	6	27	6	23	5
	Hampstead	68,416	20	2	7	4	16	2	16	2	18	4	18	1
	St. Pancras	234,379	64	13	61	8	73	13	63	13	53	8	52	20
	Islington	319,143	67	16	85	15	90	14	95	19	103	18	68	15
	St. Mary, Stoke Newington	30,936	55	9	56	3	46	12	66	11	73	14	59	14
	Hackney	198,606												
Central District.	St. Giles and St. George, Bloomsbury.	39,782	12	..	9	3	8	2	4	1	3	1	4	1
	St. Martin-in-the-Fields ..	14,616	..	..	2	..	1	..	1	1	2	1	1	..
	Strand†	25,217	2	1	6	1	2	..	1	2	5	..	5	1
	Holborn‡	34,043	14	..	14	2	21	1	14	6	11	2	5	2
	Clerkenwell	66,216	31	1	22	4	39	5	41	5	23	5	21	2
	St. Luke, Middlesex ..	42,440	19	3	17	5	19	7	16	..	18	..	24	4
	London, City of§	37,583	12	1	5	..	5	3	10	3	9	2	8	..
E. District.	Shoreditch	124,009	34	5	46	12	43	12	50	10	40	13	39	11
	Bethnal Green	129,132	80	10	72	8	60	16	62	11	65	11	51	12
	Whitechapel‖	74,420	33	2	31	1	34	3	42	6	33	7	31	8
	St. George-in-the-East ..	45,795	28	4	27	2	35	1	24	3	29	5	35	6
	Limehouse	57,376	19	7	33	1	22	4	26	5	19	6	25	3
	Mile End Old Town ..	107,592	40	10	56	12	43	5	58	7	36	5	45	10
	Poplar	166,748	71	13	107	16	88	10	70	12	81	10	75	18
S. District.	St. Saviour, Southwark ..	27,177	15	2	5	2	10	..	15	2	19	5	12	1
	St. George, Southwark ..	59,712	25	7	11	5	18	5	25	6	12	2	21	2
	Newington	115,804	46	14	33	8	48	5	41	2	35	7	44	4
	St. Olave, Southwark ..	12,723	3	..	3	..	4	..	2	1	6	2	2	..
	Bermondsey	84,682	29	5	27	7	24	4	26	7	24	6	30	8
	Rotherhithe	39,255	14	5	9	1	9	2	21	3	11	1	12	3
	Lambeth	275,203	90	7	93	16	71	11	83	17	87	15	83	16
	Battersea	150,558	49	12	53	10	31	6	45	6	55	10	38	12
	Wandsworth	156,942	37	5	36	9	45	10	37	7	37	6	35	10
	Camberwell	235,344	105	26	97	13	94	22	94	24	107	23	89	18
	Greenwich	165,413	63	14	66	7	74	10	68	16	76	14	71	14
	Lewisham	92,647	13	1	17	3	8	1	4	1	20	4	11	5
	Woolwich	40,848	5	1	14	1	10	1	7	2	7	2	7	1
	Plumstead	52,436	20	5	15	3	11	3	22	5	18	2	12	4
	Lee	36,103												
	Port of London	..	..	..	..	..	..	..	..	..	1	..	..	..

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* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 85).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

DIPHTHERIA—*continued.*

Weekly Statement, 3rd Quarters, 1893–97—*continued.*¶

33rd week, Aug. 21.		34th week, Aug. 28.		35th week, Sept. 4.		36th week, Sept. 11.		37th week, Sept. 18.		38th week, Sept. 25.		39th week, Oct. 2.		Totals for 3rd Quarters, 1893–97.		Sanitary Areas.
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
1,113	258	1,102	210	1,094	193	1,298	212	1,453	256	1,570	268	1,602	325	17,323	3,208	London. (*Administrative County.*)
31	9	31	4	23	3	31	5	32	7	42	8	35	11	491	103	Kensington.
24	5	24	7	34	8	27	6	43	8	37	5	49	11	415	84	Fulham.
14	5	20	5	12	4	7	3	13	4	24	4	24	5	265	57	Hammersmith.
19	12	13	3	27	6	24	6	25	4	34	10	25	8	392	90	Paddington.
28	5	29	4	28	3	35	7	42	7	40	7	44	7	482	82	Chelsea.
11	1	6	..	10	..	6	..	12	2	11	1	19	2	163	18	St. George, Hanover Sq.*
12	1	5	3	3	..	8	1	10	1	9	1	16	2	127	19	Westminster.
1	2	5	1	4	3	5	1	4	..	1	..	1	..	54	12	St. James, Westminster.
35	10	24	7	22	1	30	2	36	3	33	8	40	7	400	71	St. Marylebone.
12	1	6	2	10	3	7	..	12	1	9	..	8	..	159	22	Hampstead.
49	9	52	17	37	12	48	9	61	8	95	10	82	21	793	161	St. Pancras.
69	21	74	16	61	10	77	19	119	21	85	19	105	19	1,096	222	Islington.
50	7	50	9	63	7	83	10	79	15	89	12	96	16	865	139	St.Mary,StokeNewington. Hackney.
3	2	3	1	6	..	2	1	8	2	11	..	3	1	76	15	St. Giles and St. George, Bloomsbury.
2	1	3	..	2	..	2	..	1	..	2	1	1	..	20	4	St. Martin-in-the-Fields.
2	1	5	..	1	..	3	..	4	2	2	..	6	1	44	9	Strand.†
6	1	11	2	8	..	9	1	12	..	12	2	10	2	147	21	Holborn.‡
19	2	34	2	35	2	29	9	33	5	27	4	44	6	398	52	Clerkenwell.
13	4	11	2	10	3	18	5	21	3	23	1	15	1	224	38	St. Luke, Middlesex.
2	2	5	2	7	..	6	2	9	..	7	1	3	2	88	18	London, City of.§
30	4	31	2	29	10	59	5	40	8	44	3	50	9	535	104	Shoreditch.
57	10	53	6	56	5	74	7	57	12	78	13	67	14	832	135	Bethnal Green.
31	7	38	10	34	6	41	7	33	8	48	10	35	5	464	80	Whitechapel.‖
21	7	20	2	21	5	18	5	20	2	34	4	31	7	343	53	St. George-in-the-East.
25	8	25	4	32	5	26	5	23	4	37	2	22	1	334	56	Limehouse.
37	9	39	4	28	7	49	8	78	10	81	13	43	15	633	115	Mile End Old Town.
72	15	67	8	71	7	94	10	91	14	113	18	86	15	1,066	166	Poplar.
6	2	9	1	9	2	6	..	13	2	8	3	13	5	140	27	St. Saviour, Southwark.
31	8	18	3	32	2	36	4	23	6	24	8	26	7	302	65	St. George, Southwark.
52	15	46	10	43	6	47	6	28	8	35	2	51	6	549	93	Newington.
2	..	3	1	4	..	..	..	2	1	5	1	5	..	41	6	St. Olave, Southwark.
17	6	20	2	25	9	31	5	33	4	34	10	30	6	350	79	Bermondsey.
26	3	11	6	14	1	12	3	10	2	16	7	19	1	184	38	Rotherhithe.
62	12	71	15	68	8	70	15	111	15	86	15	85	23	1,060	186	Lambeth.
34	7	35	8	39	10	49	7	51	17	61	13	69	18	609	136	Battersea.
31	7	36	8	34	16	34	3	47	9	41	10	49	7	499	107	Wandsworth.
82	16	88	16	77	11	84	17	109	20	96	18	127	26	1,249	250	Camberwell.
60	11	49	12	45	12	74	9	73	15	86	17	107	29	912	180	Greenwich.
18	4	14	..	12	4	12	3	18	1	23	3	38	2	208	32	Lewisham.
4	1	5	3	8	1	8	2	4	2	6	1	2	1	87	19	Woolwich.
13	5	13	2	10	1	16	4	13	3	21	3	21	6	205	46	Plumstead. Lee.
..	..	..	..	..	..	1	..	..	..	..	..	..	..	2	..	Port of London.

§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

¶ The actual dates of the registration weeks in 1897 have been given as perhaps aiding the reader.

	Sanitary Areas.	Population (1891).	DIPHTHERIA—*continued.*															
			Weekly Statement, 4th Quarters, 1893–97.¶															
			40th week Oct. 9.		41st week, Oct. 16.		42nd week, Oct. 23.		43rd week, Oct. 30.		44th week, Nov. 6.		45th week, Nov. 13.		46th week, Nov. 20.		47th week, Nov. 27.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
	London .. .. (*Administrative County.*)	4,232,118	1,644	304	1,683	290	1,664	338	1,522	311	1,516	334	1,496	309	1,468	288	1,484	337
W. District.	Kensington	166,308	41	11	62	9	64	19	45	6	38	17	39	11	46	8	35	15
	Fulham	91,639	41	6	42	6	48	11	50	10	40	8	58	12	35	5	49	6
	Hammersmith	97,239	38	6	12	3	17	6	31	6	23	7	25	6	32	2	27	5
	Paddington	117,846	28	4	30	6	42	4	43	10	36	9	36	7	39	3	32	11
	Chelsea	96,253	41	11	39	8	33	9	43	10	52	10	47	11	51	10	49	6
	St. George, Hanover Sq.* ..	78,599	18	4	22	3	12	5	18	4	18	4	14	3	11	3	11	1
	Westminster	55,539	11	7	17	4	5	2	6	1	15	4	18	4	14	2	11	3
	St. James, Westminster ..	24,995	1	..	8	1	7	..	2	2	5	1	4	..	3	..	5	1
N. District.	St. Marylebone	142,404	36	9	53	6	32	8	28	4	83	5	25	12	33	11	38	7
	Hampstead	68,416	14	3	13	1	14	1	16	..	19	4	9	..	12	2	10	1
	St. Pancras	234,379	100	13	94	22	98	19	61	27	70	15	54	16	92	19	67	16
	Islington	319,143	89	17	118	16	92	24	100	24	73	18	83	19	91	26	104	14
	St. Mary, Stoke Newington	30,936	105	19	117	15	109	22	105	19	93	15	95	24	80	11	107	17
	Hackney	198,606																
Central District.	St. Giles and St. George, Bloomsbury.	39,782	6	1	18	1	9	2	7	2	7	1	13	2	3	1	2	1
	St. Martin-in-the-Fields ..	14,616	1	1	3	1	2	1	3	..	2	3	4	..	1	..	4	2
	Strand†	25,217	4	1	4	1	3	..	7	2	10	1	3	1	7	..	3	..
	Holborn‡	34,043	14	2	15	4	12	1	8	..	5	1	8	2	4	1	9	..
	Clerkenwell	66,216	39	12	41	9	40	9	24	2	36	4	28	6	37	9	22	3
	St. Luke, Middlesex ..	42,440	18	1	24	2	10	5	12	2	14	5	9	3	12	..	20	6
	London, City of§	37,583	4	..	4	..	6	2	9	1	5	4	6	..	5	..	4	..
E. District.	Shoreditch	124,009	40	12	47	9	49	9	40	13	29	12	45	7	41	6	46	14
	Bethnal Green	129,132	93	17	69	10	45	5	69	15	63	8	59	8	64	16	40	16
	Whitechapel‖	74,420	32	5	28	9	25	2	21	4	30	4	23	1	24	1	27	5
	St. George-in-the-East ..	45,795	32	7	18	6	34	5	19	2	27	4	19	2	13	1	11	2
	Limehouse	57,376	37	13	32	4	34	6	23	8	16	2	22	4	26	2	21	4
	Mile End Old Town ..	107,592	35	5	57	5	53	10	48	5	37	11	29	4	52	11	51	10
	Poplar	166,748	94	13	81	12	89	10	95	18	79	17	90	16	100	13	81	15
S. District.	St. Saviour, Southwark ..	27,177	13	2	12	1	12	1	13	3	13	4	13	4	10	2	7	1
	St. George, Southwark ..	59,712	21	3	23	4	32	4	17	5	24	6	26	3	19	2	19	4
	Newington	115,804	58	6	40	14	39	9	39	7	40	9	52	6	38	5	43	16
	St. Olave, Southwark ..	12,723	5	..	10	1	5	1	4	..	5	2	6	..	5	1	6	3
	Bermondsey	84,682	23	1	16	5	27	7	32	6	21	5	29	8	21	6	24	11
	Rotherhithe	39,255	21	4	6	3	14	2	17	2	10	5	6	3	18	6	7	5
	Lambeth	275,203	84	12	91	19	91	17	71	13	90	22	98	17	78	21	99	23
	Battersea	150,558	61	5	52	7	74	22	59	15	92	22	58	14	56	15	73	20
	Wandsworth	156,942	35	12	55	8	50	9	62	6	58	10	55	16	50	11	50	10
	Camberwell	235,344	124	21	124	18	148	29	120	16	118	24	134	23	106	30	120	28
	Greenwich	165,413	105	17	99	18	90	18	96	21	86	17	72	13	68	11	92	13
	Lewisham	92,647	38	7	43	10	55	11	22	7	43	7	34	7	32	8	31	3
	Woolwich	40,848	4	1	9	1	14	2	8	4	12	2	8	3	13	1	9	4
	Plumstead	52,436	40	13	35	8	29	9	29	9	29	5	40	11	25	6	18	5
	Lee	36,103																
	Port of London	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..

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* Including St. Peter's, Westminster (population, 235).

† Including Middle Temple (population, 95

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

DIPHTHERIA—*continued.*

Weekly Statement, 4th Quarters, 1893-97—*continued.*¶

48th week. Dec. 4.		49th week, Dec. 11.		50th week, Dec. 18.		51st week, Dec. 25.		52nd week, Jan. 1, 1898.		53rd week—1 year only—in 1896.		Totals for 4th Quarters, 1893-97.		Grand Totals for Years, 1893-97.		Sanitary Areas.
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
1,352	287	1,369	326	1,371	315	1,236	271	1,175	274	318	49	19,298	4,023	63,090	13,026	London. (*Administrative County.*)
48	7	50	10	32	14	36	6	33	7	13	1	582	141	1,746	401	Kensington.
49	13	49	13	43	9	40	13	52	13	9	1	605	126	1,698	386	Fulham.
36	3	13	7	26	6	14	5	19	2	3	1	306	65	1,043	229	Hammersmith.
34	8	30	10	31	6	39	4	24	5	5	1	449	88	1,496	339	Paddington.
32	11	39	5	36	5	40	5	32	13	7	1	541	115	1,654	330	Chelsea.
10	..	8	3	15	3	18	2	15	5	5	2	195	42	622	118	St. George, Hanover Sq.*
5	..	15	4	14	5	10	..	11	4	1	..	153	40	509	104	Westminster.
7	2	3	..	7	1	2	..	5	..	3	..	62	8	223	39	St. James, Westminster.
23	10	31	4	32	6	22	3	32	8	7	1	425	94	1,463	322	St. Marylebone.
21	..	8	1	11	1	19	1	7	4	2	..	175	19	694	118	Hampstead.
56	13	54	14	61	13	48	10	30	12	16	3	901	212	2,971	663	St. Pancras.
87	12	81	26	89	30	80	26	95	28	31	5	1,213	285	4,269	951	Islington.
93	25	79	19	114	26	71	16	87	22	13	2	1,268	252	3,613	697	St. Mary, Stoke Newington. Hackney.
4	..	5	..	3	..	2	1	6	2	..	..	85	14	313	63	St. Giles and St. George, Bloomsbury.
8	1	2	1	1	..	..	..	1	..	..	..	32	10	90	27	St. Martin-in-the-Fields.
4	3	4	2	5	3	3	..	6	..	..	..	63	14	218	52	Strand.†
7	..	5	..	9	..	5	..	16	3	2	..	119	14	479	77	Holborn.‡
26	3	24	6	35	6	19	4	15	7	3	1	389	81	1,285	234	Clerkenwell.
9	1	12	5	12	3	9	1	13	4	7	1	181	39	653	128	St. Luke, Middlesex.
8	1	7	2	10	1	5	1	6	..	4	..	83	12	300	46	London, City of.§
33	7	43	10	34	6	30	10	20	5	9	..	506	120	1,792	422	Shoreditch.
40	14	40	7	44	10	48	7	52	8	9	2	735	143	2,705	529	Bethnal Green.
27	9	42	5	18	6	23	7	24	6	7	1	351	65	1,389	247	Whitechapel.‖
18	8	25	5	20	4	19	2	17	2	3	..	275	50	1,133	221	St. George-in-the-East.
30	3	24	6	16	9	9	3	13	2	4	..	307	66	1,098	235	Limehouse.
37	4	42	10	57	9	34	12	33	4	15	2	580	102	2,244	431	Mile End Old Town.
76	9	87	17	72	11	97	18	71	10	20	3	1,132	182	3,884	653	Poplar.
13	..	10	3	6	3	8	1	7	..	3	..	140	25	419	80	St. Saviour, Southwark.
12	4	16	2	14	6	11	2	11	7	3	1	248	53	845	179	St. George, Southwark.
36	9	38	5	28	8	40	7	32	8	11	2	534	111	1,780	342	Newington.
8	..	3	2	3	1	3	1	8	1	4	1	75	14	161	25	St. Olave, Southwark.
29	6	16	10	20	8	21	5	22	6	4	1	305	85	1,135	310	Bermondsey.
9	1	4	2	12	1	6	..	5	1	5	1	140	36	604	140	Rotherhithe.
77	21	83	26	71	16	57	18	59	15	16	5	1,065	245	3,544	720	Lambeth.
64	13	61	12	57	12	68	20	47	9	5	..	827	186	2,544	563	Battersea.
42	6	55	8	53	12	39	7	24	3	14	2	642	120	1,878	391	Wandsworth.
117	25	81	25	98	25	116	22	100	21	30	5	1,536	312	4,728	931	Camberwell.
75	15	88	23	89	14	64	14	51	13	9	..	1,084	207	3,360	673	Greenwich.
23	7	45	5	29	4	19	5	28	4	10	1	452	86	1,070	208	Lewisham.
8	5	19	4	13	5	16	3	6	..	2	2	140	37	392	100	Woolwich.
21	8	26	7	32	7	26	9	34	10	4	..	388	107	1,078	302	Plumstead. Lee.
..	..	2	..	..	..	..	..	6	..	..	..	9	..	18	..	Port of London.

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§ Including Inner Temple (population, 96).

‖ Including Tower of London (population, 868).

¶ The actual dates of the registration weeks in 1897 have been given as perhaps aiding the reader.

	Sanitary Areas.	Population (1891).	ENTERIC FEVER. Weekly Statement, 1st Quarters, 1893-97.¶											
			1st week, Jan. 9.		2nd week, Jan. 16.		3rd week, Jan. 23.		4th week, Jan. 30.		5th week, Feb. 6.		6th week. Feb. 13.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
	London .. .. (*Administrative County.*)	4,232,118	339	50	316	68	299	56	313	54	286	58	260	38
W. District.	Kensington	166,308	11	2	13	1	18	3	8	6	9	1	2	1
	Fulham	91,639	8	3	3	1	2	..	1	..	1	2	6	..
	Hammersmith	97,239	5	..	6	1	5	..	8	4	7	..	4	..
	Paddington	117,846	10	2	7	3	5	..	9	4	2	..	4	..
	Chelsea	96,253	7	1	11	5	10	..	3	1	3	2	10	1
	St. George, Hanover Sq.* ..	78,599	2	1	10	1	5	1	4	3	5	..	4	..
	Westminster	55,539	..	1	3	..	4	..	4	..	2	2	1	..
	St. James, Westminster ..	24,995	1	1	..	..	1	1	1	..	3	..	..	..
N. District.	St. Marylebone	142,404	16	..	10	2	13	8	11	2	12	3	7	..
	Hampstead	68,416	5	1	9	..	5	1	5	1	1	1	4	2
	St. Pancras	234,379	20	6	21	3	16	2	11	..	20	3	15	5
	Islington	319,143	22	3	19	5	27	5	21	2	14	4	11	2
	St. Mary, Stoke Newington	30,936	32	2	33	3	23	3	23	3	16	3	15	4
	Hackney	198,606												
Central District.	St. Giles and St. George, Bloomsbury.	39,782	2	..	1	1	5	..	3	..	4	..	4	..
	St. Martin-in-the-Fields ..	14,616	1	..	3	..	2	..	3	..	2	..	1	..
	Strand†	25,217	1	..	3	1	1	1	6	1	..	..	2	1
	Holborn‡	34,043	1	..	1	..	1	..	4	1	3	..	2	..
	Clerkenwell	66,216	7	..	6	..	3	..	9	1	7	4	7	..
	St. Luke, Middlesex ..	42,440	6	..	4	..	6	..	1	..	..	..	5	1
	London, City of§	37,583	3	..	2	2	6	3	..	1	5	2	2	2
E. District.	Shoreditch	124,009	11	1	5	1	10	..	10	3	4	1	6	2
	Bethnal Green	129,132	11	2	13	7	7	1	17	1	15	3	12	2
	Whitechapel‖	74,420	9	..	2	4	1	2	3	1	5	1	4	1
	St. George-in-the-East ..	45,795	3	1	2	..	6	3	5	1	9	2	2	..
	Limehouse	57,376	5	1	1	1	2	..	5	1	1	1	5	..
	Mile End Old Town ..	107,592	6	2	9	3	5	1	14	1	5	..	7	..
	Poplar	166,748	11	4	17	3	12	..	10	2	18	4	17	..
S. District.	St. Saviour, Southwark ..	27,177	..	..	2	..	1	..	1	..	1	..	1	..
	St. George, Southwark ..	59,712	1	..	2	..	6	2	3	..	11	..	1	1
	Newington	115,804	6	..	17	2	9	1	8	..	6	..	4	2
	St. Olave, Southwark ..	12,723	1	..	1	..	1	..	..	..	..	1	..	..
	Bermondsey	84,682	7	2	4	1	3	..	6	..	5	..	9	..
	Rotherhithe	39,255	14	2	8	..	2	..	8	3	3	..	9	2
	Lambeth	275,203	27	8	17	4	18	7	24	1	22	2	12	3
	Battersea	150,558	17	3	8	1	12	1	19	2	21	4	16	1
	Wandsworth	156,942	14	3	12	4	15	5	18	1	15	5	15	1
	Camberwell	235,344	12	3	12	3	11	2	13	3	12	3	13	1
	Greenwich	165,413	10	..	7	1	4	2	8	1	8	3	11	1
	Lewisham	92,647	7	..	8	3	4	1	2	1	3	1	6	..
	Woolwich	40,848	1	2	..	1	2	..	1	..	..	..	1	1
	Plumstead	52,436	5	2	3	..	9	..	2	2	6	..	2	1
	Lee	36,103												
	Port of London	..	1	..	1	..	1	..	1	..	..	..	1	..

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* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

Enteric Fever—*continued.*																
Weekly Statement, 1st Quarter, 1893-97—*continued.*¶														Totals for 1st Quarters, 1893-97.		Sanitary Areas.
7th week, Feb. 20.		8th week, Feb. 27.		9th week, Mar. 6.		10th week, Mar. 13.		11th week, Mar. 20.		12th week, Mar. 27.		13th week, April 3.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
272	41	207	42	199	49	205	41	192	39	188	37	161	36	3,237	618	London. (*Administrative County.*)
5	..	3	1	4	3	6	..	6	1	8	..	2	1	95	20	Kensington.
8	2	2	..	8	..	3	2	2	..	1	..	2	1	47	11	Fulham.
3	1	3	1	4	3	6	1	5	3	2	..	6	..	64	14	Hammersmith.
2	1	4	1	7	2	5	..	3	1	5	..	3	..	66	14	Paddington.
14	1	9	2	4	2	8	1	5	1	7	2	6	2	97	21	Chelsea.
6	1	..	.	3	2	2	..	4	3	2	1	2	..	49	13	St. George, Hanover Sq.*
6	..	2	..	3	..	5	..	2	..	1	..	2	..	35	3	Westminster.
..	..	..	..	..	..	2	..	1	2	..	..	..	..	9	4	St. James, Westminster.
9	1	4	3	5	1	4	..	5	1	7	2	4	2	107	25	St. Marylebone.
9	..	3	..	4	..	2	1	4	..	1	..	2	..	54	7	Hampstead.
11	1	15	2	7	2	12	4	9	1	7	..	2	2	166	31	St. Pancras.
16	5	19	6	10	1	9	5	23	3	13	2	10	4	214	47	Islington.
10	1	9	2	9	1	13	1	14	3	14	1	12	4	223	31	St. Mary, Stoke Newington. Hackney.
2	1	3	..	2	1	3	1	..	1	..	..	..	..	29	5	St. Giles and St. George, Bloomsbury.
..	..	..	1	..	..	..	1	1	..	..	..	..	..	13	2	St. Martin-in-the-Fields.
1	..	..	..	..	..	..	..	..	..	1	..	..	..	15	4	Strand.†
3	..	1	..	3	2	2	..	1	..	2	..	2	..	26	3	Holborn.‡
9	1	3	3	2	..	3	..	7	..	6	1	6	..	75	10	Clerkenwell.
7	..	5	..	3	2	1	..	2	..	1	..	1	..	42	3	St. Luke, Middlesex.
..	..	2	1	2	..	..	..	1	..	1	1	..	..	24	12	London, City of.§
7	2	4	..	7	..	4	..	5	..	1	2	3	1	77	13	Shoreditch.
9	..	4	1	8	2	3	1	13	3	3	..	4	..	118	23	Bethnal Green.
2	..	5	1	5	..	1	..	3	..	5	1	2	..	47	11	Whitechapel.‖
2	..	4	2	3	..	1	..	2	..	2	..	2	..	43	9	St. George-in-the-East.
8	1	3	..	..	1	3	1	3	1	7	1	1	1	44	10	Limehouse.
4	2	4	..	4	..	10	2	7	1	5	..	3	2	83	14	Mile End Old Town.
16	1	11	..	13	3	11	4	6	1	8	4	13	1	163	27	Poplar.
3	..	1	1	..	..	1	..	1	..	1	1	1	..	14	2	St. Saviour, Southwark.
4	..	3	..	1	1	1	..	..	..	3	..	4	1	40	5	St. George, Southwark.
7	1	5	..	8	1	5	2	2	2	3	2	6	3	86	16	Newington.
..	..	..	..	1	..	..	..	..	..	1	1	1	..	6	2	St. Olave, Southwark.
8	3	6	2	3	4	1	1	2	..	5	1	5	..	64	14	Bermondsey.
2	..	2	..	2	1	5	..	2	1	2	..	2	..	61	9	Rotherhithe.
14	2	14	2	9	2	14	2	14	3	13	4	14	2	212	42	Lambeth.
11	2	9	2	7	3	11	3	3	..	6	..	6	..	146	22	Battersea.
16	2	4	..	13	2	12	..	9	..	6	2	5	3	154	28	Wandsworth.
17	5	10	3	17	1	19	3	14	4	18	5	7	4	175	40	Camberwell.
15	4	21	4	10	6	11	4	5	1	14	1	12	1	136	29	Greenwich.
2	..	4	..	4	..	3	1	1	..	2	.	4	..	50	7	Lewisham.
2	..	1	1	..	..	2	..	4	1	..	..	1	..	15	6	Woolwich.
2	..	5	..	4	..	1	..	1	1	4	2	2	1	46	9	Plumstead. Lee.
..	..	..	..	..	..	..	..	1	..	..	..	1	..	7	..	Port of London.

§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).
¶ The actual dates of the registration weeks in 1897 have been given as perhaps aiding the reader.

	Sanitary Areas.	Population (1891).	Enteric Fever—*continued.* Weekly Statement, 2nd Quarters, 1893-97.¶ 14th week, April 10.		15th week, April 17.		16th week, April 24.		17th week, May 1.		18th week, May 8.		19th week, May 15.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
	London	4,232,118	214	32	157	26	189	31	196	33	195	36	207	33
	(*Administrative County.*) ..													
W. District.	Kensington	166,308	7	..	4	1	5	..	5	3	10	1	7	..
	Fulham	91,639	4	1	4	..	3	2	4	..	4	1	2	..
	Hammersmith	97,239	8	1	3	..	4	..	4	2	2	2	4	2
	Paddington	117,846	9	1	7	..	5	3	5	4	6	1	8	1
	Chelsea	96,253	..	..	4	..	4	..	1	..	2	..	5	1
	St. George, Hanover Sq.*..	78,599	5	..	1	..	4	1	1	..	5	2	4	..
	Westminster	55,539	1	..	2	..	..	..	5	..	4	1	1	1
	St. James, Westminster ..	24,995	..	..	..	..	1	..	..	..	..	..	..	..
N. District.	St. Marylebone	142,404	11	..	3	1	11	1	7	1	8	2	6	1
	Hampstead	68,416	5	..	3	1	4	1	3	..	2	..	3	1
	St. Pancras	234,379	11	1	4	1	7	1	13	1	4	..	6	1
	Islington	319,143	13	5	6	1	10	1	12	3	6	5	18	..
	St. Mary, Stoke Newington	30,936	14	3	12	3	8	2	13	1	14	1	17	2
	Hackney	198,606												
Central District.	St. Giles and St. George, Bloomsbury.	39,782	..	..	..	..	..	..	1	..	3	..	2	..
	St. Martin-in-the-Fields ..	14,616	..	..	..	..	..	..	..	..	..	..	..	..
	Strand†..	25,217	..	..	..	..	..	..	..	..	1	..	..	..
	Holborn‡	34,043	1	..	2	..	..	..	1	1	1	1	1	..
	Clerkenwell	66,216	4	..	2	..	4	..	5	1	3	1	7	..
	St. Luke, Middlesex ..	42,440	..	..	3	1	1	1	1	..	6	1	..	..
	London, City of§	37,583	3	2	1	..	1	..	..	..	1	1	..	1
E. District.	Shoreditch	124,009	7	..	2	1	1	1	11	..	6	3	5	1
	Bethnal Green	129,132	8	3	6	..	11	..	11	1	13	..	6	2
	Whitechapel‖	74,420	2	..	2	..	5	..	1	1	3	..	1	..
	St. George-in-the-East ..	45,795	3	..	1	..	4	1	5	..	..	1	4	1
	Limehouse	57,376	6	..	2	..	4	..	1	1	5	..	7	..
	Mile End Old Town ..	107,592	6	..	4	..	5	2	5	..	7	..	5	1
	Poplar	166,748	7	3	10	2	18	2	13	2	13	4	16	2
S. District.	St. Saviour, Southwark ..	27,177	1	..	..	1	..	..	..	..	1	..	1	..
	St. George, Southwark ..	59,712	5	1	1	..	1	..	1	1	3	..	3	1
	Newington	115,804	4	..	5	1	6	..	2	..	4	..	6	3
	St. Olave, Southwark ..	12,723	..	..	1	1	1	..	1	..	..	1	..	..
	Bermondsey	84,682	5	2	8	..	2	..	2	..	5	..	3	..
	Rotherhithe	39,255	5	..	2	..	2	1	1	1	..	1	2	..
	Lambeth	275,203	21	4	16	5	17	2	18	1	17	..	18	3
	Battersea	150,558	6	2	4	1	7	2	10	1	5	1	7	..
	Wandsworth	156,942	9	..	7	3	6	3	11	1	3	1	10	2
	Camberwell	235,344	13	..	11	1	9	2	6	2	13	1	8	2
	Greenwich	165,413	4	..	8	..	11	2	8	2	8	1	7	2
	Lewisham	92,647	1	1	3	..	3	..	3	1	2	1	3	1
	Woolwich	40,848	1	1	1	..	.	..	..	..	..	..	..	..
	Plumstead	52,436	3	1	2	1	4	..	4	1	3	1	4	1
	Lee	36,103												
	Port of London	..	1	..	..	..	..	..	1	..	1	..	..	..

* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

Enteric Fever—*continued.*

Weekly Statement, 2nd Quarters, 1893-97—*continued.*

20th week, May 22.¶		21st week, May 29.		22nd week, June 5.		23rd week, June 12.		24th week, June 19.		25th week, June 26.		26th week, July 3.		Totals for 2nd Quarters, 1893-97.		Sanitary Areas.
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
261	37	259	43	222	40	212	38	257	25	293	46	256	42	2,917	462	London. (*Administrative County.*)
5	2	4	1	6	..	3	..	5	..	5	1	3	2	69	11	Kensington.
1	2	4	..	4	..	3	..	5	..	5	2	6	..	49	8	Fulham.
2	1	2	..	3	1	2	..	7	..	3	4	3	1	47	14	Hammersmith
4	1	4	2	5	2	4	3	4	..	3	1	3	..	67	19	Paddington.
4	..	2	..	4	..	6	1	2	1	3	1	5	..	42	4	Chelsea.
7	..	5	1	1	..	4	..	4	..	4	..	3	..	48	4	St. George, Hanover Sq.*
4	1	2	..	3	1	2	..	8	..	5	..	3	..	40	4	Westminster.
1	..	..	..	2	1	..	..	..	..	2	1	..	..	6	2	St. James, Westminster.
10	..	7	4	5	1	13	1	1	..	4	..	13	3	99	15	St. Marylebone.
6	1	3	..	2	..	2	..	..	1	..	..	5	..	38	5	Hampstead.
9	1	11	4	7	2	3	2	16	..	30	3	20	3	141	20	St. Pancras.
18	1	15	..	9	4	11	4	21	2	16	..	18	2	173	28	Islington.
16	2	15	2	10	3	12	4	14	2	9	3	11	2	171	30	St. Mary, Stoke Newington. Hackney.
1	1	4	1	3	..	1	..	1	..	2	2	1	..	19	4	St. Giles and St. George, Bloomsbury.
..	..	2	1	..	..	1	..	..	..	1	..	2	..	6	1	St. Martin-in-the-Fields.
..	1	..	..	..	..	..	..	1	1	..	..	..	..	2	2	Strand.†
3	1	5	..	..	..	2	..	2	2	5	..	2	1	25	6	Holborn.‡
6	1	6	1	4	..	4	..	7	..	7	1	8	..	67	5	Clerkenwell.
3	1	1	..	2	1	1	..	..	..	5	..	2	..	25	5	St. Luke, Middlesex.
2	..	2	1	2	..	..	..	2	..	3	1	2	..	19	6	London, City of.§
8	1	5	..	6	..	5	..	9	..	13	3	9	2	87	12	Shoreditch.
6	1	11	..	4	..	13	3	10	3	10	2	16	4	125	19	Bethnal Green.
1	..	3	..	4	1	3	1	1	..	4	..	2	1	32	4	Whitechapel.‖
5	..	4	1	1	..	3	1	..	..	4	..	2	..	36	5	St. George-in-the-East.
1	..	1	..	3	1	4	..	7	..	10	1	3	2	54	5	Limehouse.
6	1	7	2	6	4	..	..	4	..	18	..	10	2	83	12	Mile End Old Town.
14	3	15	4	13	1	6	2	25	4	41	5	20	4	211	38	Poplar.
..	..	..	..	1	..	1	..	2	..	..	..	4	1	11	2	St. Saviour, Southwark.
1	..	5	..	4	1	4	1	4	..	6	2	2	1	40	8	St. George, Southwark.
3	..	6	1	7	4	7	..	8	1	8	2	5	2	71	14	Newington.
..	..	..	..	..	..	1	..	..	..	..	..	..	..	4	2	St. Olave, Southwark.
4	..	4	2	5	..	5	1	8	1	..	..	7	..	58	6	Bermondsey.
..	..	3	1	4	1	4	..	1	..	3	..	2	2	29	7	Rotherhithe.
14	3	7	1	10	2	14	2	13	2	11	3	17	..	193	28	Lambeth.
10	1	11	..	10	1	8	1	9	..	3	1	5	3	95	14	Battersea.
8	1	8	2	5	1	4	1	10	..	9	..	5	..	95	15	Wandsworth.
3	2	11	1	5	1	12	1	18	2	9	2	12	2	130	19	Camberwell.
11	1	7	5	8	1	6	2	3	..	6	..	9	..	96	17	Greenwich
7	2	1	1	1	1	..	..	6	..	6	2	4	..	40	10	Lewisham.
1	..	12	1	6	..	10	..	6	2	8	..	5	1	50	4	Woolwich.
56	4	44	3	41	4	25	7	13	1	9	3	6	1	214	28	Plumstead. Lee.
..	..	..	..	..	..	3	..	..	..	3	..	1	..	10	..	Port of London.

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§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

¶ The actual dates of the registration weeks in 1897 have been given as perhaps aiding the reader.

	Sanitary Areas.	Population (1891).	ENTERIC FEVER—*continued.* Weekly Statement, 3rd Quarters, 1893-97.¶											
			27th week, July 10.		28th week, July 17.		29th week, July 24.		30th week, July 31.		31st week, Aug. 7.		32nd week, Aug. 14.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
	London .. .. (*Administrative County.*)	4,232,118	227	39	251	45	235	28	295	39	316	56	338	49
W. District.	Kensington	166,308	6	..	4	1	6	3	9	2	4	1	11	..
	Fulham	91,639	4	..	5	1	3	..	4	..	5	..	1	1
	Hammersmith	97,239	2	..	3	..	4	..	3	..	3	1	7	..
	Paddington	117,846	..	1	3	..	7	..	8	4	12	2	2	1
	Chelsea	96,253	3	..	5	1	6	..	8	2	8	..	4	..
	St. George, Hanover Sq.* ..	78,590	4	..	3	..	1	..	5	..	2	1	7	1
	Westminster	55,539	5	1	3	..	..	..	4	..	11	3	5	..
	St. James, Westminster ..	24,995	2	1	1	..	2	..	..	..	..	1	1	..
N. District.	St. Marylebone	142,404	8	1	5	3	7	3	9	1	9	2	11	3
	Hampstead	68,416	3	..	2	1	7	1	5	..	5	..	6	..
	St. Pancras	234,379	6	3	11	1	22	..	21	2	22	2	29	4
	Islington	319,143	19	1	15	..	15	5	15	3	14	1	25	3
	St. Mary, Stoke Newington	30,936	15	1	20	5	19	2	24	3	21	7	18	2
	Hackney	198,606												
Central District.	St. Giles and St. George, Bloomsbury.	39,782	..	..	4	1	1	..	..	..	3	..	4	..
	St. Martin-in-the-Fields ..	14,616	2	1	1	..	2	..	..	..	..	..	1	..
	Strand†	25,217	1	1	..	..	2	..	1	..	..	1	3	..
	Holborn‡	34,043	2	1	3	1	1	..	5	..	5	..	6	1
	Clerkenwell	66,216	6	1	3	2	7	..	5	..	8	2	7	..
	St. Luke, Middlesex ..	42,440	3	2	4	1	3	..	5	1	3	2	2	2
	London, City of §	37,583	2	..	2	..	2	..	2	..	2	..	..	..
E. District.	Shoreditch	124,009	7	2	16	1	7	4	13	2	15	..	24	2
	Bethnal Green	129,132	20	1	15	3	4	2	10	1	10	2	13	..
	Whitechapel‖	74,420	4	1	8	1	3	..	7	1	7	..	6	..
	St. George-in-the-East ..	45,795	1	..	..	..	2	..	..	..	2	..	2	..
	Limehouse	57,376	4	2	12	..	4	..	5	1	4	1	12	1
	Mile End Old Town ..	107,592	8	3	9	2	6	1	9	..	12	3	15	2
	Poplar	166,748	27	3	18	5	20	1	25	4	32	9	14	3
S. District.	St. Saviour, Southwark ..	27,177	1	..	1	1	4	..	1	1	1	..	3	1
	St. George, Southwark ..	59,712	3	..	3	..	6	1	5	1	4	2	2	1
	Newington	115,804	6	1	2	1	5	..	12	1	9	2	5	1
	St. Olave, Southwark ..	12,723	2	..	..	..	..	..	..	..	..	..	2	..
	Bermondsey	84,682	2	..	3	..	4	..	6	..	3	..	3	1
	Rotherhithe	39,255	1	..	2	..	1	..	1	..	4	1	3	1
	Lambeth	275,203	11	3	12	4	12	2	9	..	19	2	24	4
	Battersea	150,558	4	2	5	..	9	..	9	3	10	2	10	2
	Wandsworth	156,942	5	1	10	..	6	1	9	..	7	1	11	2
	Camberwell	235,344	11	3	14	3	9	..	8	2	19	2	10	2
	Greenwich	165,413	8	1	9	1	10	1	13	2	6	2	15	4
	Lewisham	92,647	2	..	4	1	..	..	8	..	4	..	4	2
	Woolwich	40,848	2	..	4	2	1	1	3	..	1	1	1	1
	Plumstead	52,436	5	1	6	2	5	..	7	2	10	..	6	1
	Lee	36,103												
	Port of London	..	..	..	1	..	..	..	2	..	..	..	2	..

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* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 263), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

ENTERIC FEVER—*continued.*

Weekly Statement, 3rd Quarters, 1893-97—*continued.*¶

33rd week, Aug. 21.		34th week, Aug. 28.		35th week, Sept. 4.		36th week, Sept. 11.		37th week, Sept. 18.		38th week, Sept. 25.		39th week, Oct. 2.		Totals for 3rd Quarters, 1893-97.		Sanitary Areas.
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
315	78	336	59	411	47	483	78	523	69	508	83	461	68	4,697	738	London. (*Administrative County.*)
16	..	9	..	8	2	6	3	13	1	7	..	15	1	114	14	Kensington.
3	1	8	2	13	1	6	..	4	1	7	..	8	3	71	10	Fulham.
8	4	5	..	9	1	9	3	6	..	4	..	6	1	69	10	Hammersmith.
2	1	3	1	4	..	10	1	10	1	5	3	4	1	70	16	Paddington.
9	2	3	1	5	1	13	..	15	1	9	2	7	4	95	14	Chelsea.
1	1	4	1	5	..	5	..	4	..	9	5	7	2	57	11	St. George, Hanover Sq.*
1	2	1	..	1	..	..	..	6	..	1	1	2	..	40	7	Westminster.
1	1	..	1	1	..	4	1	4	..	1	1	..	..	17	6	St. James, Westminster.
12	2	14	2	14	2	11	2	22	4	11	..	10	1	143	26	St. Marylebone.
2	..	1	..	4	1	4	1	3	..	9	3	4	1	55	8	Hampstead.
25	4	15	4	19	..	26	7	38	6	41	3	33	4	307	40	St. Pancras.
19	2	27	4	25	5	43	7	47	4	50	7	37	5	351	47	Islington.
20	5	25	6	35	4	49	6	41	6	56	8	53	4	396	59	St.Mary,StokeNewington. Hackney.
4	2	1	..	7	1	2	..	4	1	4	1	4	..	38	6	St. Giles and St. George, Bloomsbury.
..	1	..	..	..	..	3	1	..	..	1	..	2	..	12	3	St. Martin-in-the-Fields.
1	..	1	2	..	..	3	..	1	1	2	..	1	..	16	5	Strand.†
3	1	1	..	6	..	3	2	..	2	2	2	3	..	40	10	Holborn.‡
12	1	11	1	4	1	6	3	6	2	6	2	3	1	84	16	Clerkenwell.
1	..	6	1	1	2	6	..	6	..	5	1	2	2	47	14	St. Luke, Middlesex.
3	1	6	..	5	1	2	..	8	..	..	3	6	..	40	5	London, City of.§
10	6	12	5	21	1	21	3	25	2	16	4	19	3	206	35	Shoreditch.
9	4	7	1	14	..	18	2	31	2	17	4	12	2	180	24	Bethnal Green.
9	1	5	..	7	1	6	..	9	1	5	1	7	..	83	7	Whitechapel.‖
3	..	1	..	5	2	7	..	4	..	7	..	8	2	42	4	St. George-in-the-East.
4	1	6	3	9	..	10	1	10	1	8	2	6	1	94	14	Limehouse.
11	2	19	3	21	1	15	2	16	4	19	4	12	3	172	30	Mile End Old Town.
24	8	24	2	26	2	37	8	52	1	40	3	40	3	379	52	Poplar.
3	..	1	1	1	..	3	..	1	..	2	..	..	..	22	4	St. Saviour, Southwark.
4	1	2	2	4	..	10	3	5	7	9	..	5	1	62	19	St. George, Southwark.
8	2	10	2	18	2	12	..	17	3	20	1	15	2	139	18	Newington.
..	..	..	..	2	..	1	2	..	1	1	1	2	2	10	6	St. Olave, Southwark.
3	2	3	..	7	1	20	2	8	1	10	1	5	..	77	9	Bermondsey.
3	1	1	..	3	1	8	..	3	2	14	3	6	1	49	9	Rotherhithe.
15	3	20	1	28	2	22	2	17	2	22	7	28	3	239	35	Lambeth.
5	2	11	1	10	2	11	2	15	3	8	2	23	3	130	25	Battersea.
8	5	9	1	12	..	9	2	9	2	13	1	14	2	122	17	Wandsworth.
19	3	24	5	22	3	22	5	34	5	23	4	17	3	233	41	Camberwell.
12	1	22	4	19	3	22	5	18	2	28	2	21	3	203	30	Greenwich.
10	3	10	1	2	3	5	1	1	..	4	..	5	1	59	12	Lewisham.
3	..	3	..	3	..	3	1	1	..	1	1	4	1	30	8	Woolwich.
5	2	3	1	5	1	6	..	4	..	11	..	5	2	78	12	Plumstead. Lee.
4	..	2	..	6	..	4	..	5	..	..	..	..	..	26	..	Port of London.

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§ Including Inner Temple (population, 96).

‖ Including Tower of London (population, 868).

¶ The actual dates of the registration weeks in 1897 have been given as perhaps aiding the reader.

ENTERIC FEVER—*continued.*

Weekly Statement, 4th Quarters, 1893-97.¶

	Sanitary Areas.	Population (1891).	40th week, Oct. 9.		41st week, Oct. 16.		42nd week, Oct. 23.		43rd week, Oct. 30.		44th week, Nov. 6.		45th week, Nov. 13.		46th week, Nov. 20.		47th week, Nov. 27.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
	London .. .. (*Administrative County.*)	4,232,118	556	76	500	92	567	90	508	81	533	97	539	94	567	95	549	98
W. District.	Kensington	166,308	18	4	9	3	18	4	18	1	26	6	29	3	19	5	16	3
	Fulham	91,639	13	..	9	4	12	3	11	3	8	..	9	1	13	3	13	3
	Hammersmith	97,239	11	2	6	2	6	1	5	..	4	2	7	1	14	2	8	1
	Paddington	117,846	12	..	10	2	14	..	5	1	6	1	6	1	12	2	13	3
	Chelsea..	96,253	11	..	6	3	19	4	9	3	12	1	16	..	9	1	7	5
	St. George, Hanover Sq.*..	78,599	6	1	7	2	9	2	8	1	13	4	9	..	14	..	14	4
	Westminster	55,539	5	..	4	..	6	..	6	3	7	3	8	..	6	..	3	2
	St. James, Westminster ..	24,995	2	2	5	1	3	1	2	1	4	1	4	2	3	1	5	..
N. District.	St. Marylebone	142,404	27	..	17	2	19	2	12	2	21	6	19	1	19	2	29	6
	Hampstead	68,416	11	2	4	1	9	..	6	..	6	1	9	..	4	1	14	2
	St. Pancras	234,379	39	4	34	4	35	5	30	10	37	5	32	10	31	8	31	7
	Islington	319,143	47	6	45	4	47	7	41	5	47	5	37	9	40	7	38	5
	St. Mary, Stoke Newington	30,936	37	9	56	10	38	4	54	6	49	14	57	7	53	9	45	10
	Hackney	198,606																
Central District.	St. Giles and St. George, Bloomsbury.	39,782	4	..	4	2	6	1	6	1	2	..	3	2	7	1	3	..
	St. Martin-in-the-Fields ..	14,616	4	..	1	2	3	..	4	..	1	..	3	..	2	..	3	..
	Strand†	25,217	2	..	8	..	1	..	6	1	2	..	8	..	3	..	3	..
	Holborn‡	34,043	3	1	4	..	4	2	3	..	6	2	4	1	9	..	8	3
	Clerkenwell	66,216	4	1	6	1	15	2	7	1	12	3	9	4	9	2	9	4
	St. Luke, Middlesex ..	42,440	5	1	2	..	2	..	6	1	4	1	6	1	7	..	4	1
	London, City of§	37,583	6	2	4	4	9	2	5	1	5	1	2	1	3	..	5	1
E. District.	Shoreditch	124,009	21	4	23	4	23	1	11	..	11	1	14	3	14	..	10	2
	Bethnal Green	129,132	25	4	17	4	31	4	20	4	21	2	14	6	25	4	20	1
	Whitechapel‖	74,420	9	3	9	1	9	1	6	1	6	3	6	..	10	..	11	3
	St. George-in-the-East ..	45,795	11	2	5	..	6	4	8	2	13	..	12	..	6	..	13	..
	Limehouse	57,376	10	..	6	1	11	3	15	1	4	2	8	3	9	1	8	1
	Mile End Old Town ..	107,592	16	3	14	4	16	4	9	3	23	2	12	2	16	5	15	1
	Poplar	166,748	43	4	40	6	31	6	43	3	37	2	35	4	38	7	39	5
S District.	St. Saviour, Southwark ..	27,177	1	..	..	..	1	..	2	..	2	..	3	1	..	..	4	..
	St. George, Southwark ..	59,712	2	1	7	..	7	..	7	2	2	2	7	2	7	..	9	1
	Newington	115,804	6	5	13	4	17	2	5	1	13	2	13	1	8	1	4	2
	St. Olave, Southwark ..	12,723	..	..	1	..	2	1	1	..	1	..	2	..	1	..	..	1
	Bermondsey	84,682	10	..	2	1	3	..	8	..	11	2	8	4	6	4	10	2
	Rotherhithe	39,255	3	2	4	..	2	1	4	1	1	..	3	..	3	..	7	..
	Lambeth	275,203	21	1	29	6	35	3	19	4	28	3	27	3	25	6	23	3
	Battersea	150,558	15	4	22	3	19	3	16	3	11	3	20	1	19	3	21	4
	Wandsworth	156,942	17	4	14	3	13	3	15	1	15	1	18	4	21	9	22	..
	Camberwell	235,344	38	3	19	2	26	5	40	6	19	8	19	3	25	1	20	4
	Greenwich	165,413	20	1	19	5	23	7	23	7	24	7	21	7	29	5	22	5
	Lewisham	92,647	10	..	6	1	7	..	4	..	4	..	12	2	6	1	8	1
	Woolwich	40,848	1	..	1	..	2	1	1	1	7	..	1	..	2	1	4	1
	Plumstead	52,436	7	..	6	..	8	1	6	..	8	1	7	4	20	3	7	1
	Lee	36,103																
	Port of London	..	4	..	2	..	..	..	1	..	..	..	..	..	..	..	3	..

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* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

ENTERIC FEVER—*continued.*

Weekly Statement, 4th Quarters, 1893-97—*continued.*¶

48th week, Dec. 4.		49th week, Dec. 11.		50th week, Dec. 18.		51st week, Dec. 25.		52nd week, Jan. 1, 1898.		53rd week —1 year only – in 1896.		Totals for 4th Quarters, 1893-97.		Grand Totals for Years, 1893-97.		Sanitary Areas.
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
510	91	500	87	485	100	425	75	328	94	81	12	6,648	1,182	17,499	3,000	London. (*Administrative County.*)
17	4	13	1	17	3	15	1	12	6	9	1	236	45	514	90	Kensington.
4	1	4	6	4	..	9	1	1	1	2	..	112	26	279	55	Fulham.
7	3	10	..	5	4	10	3	8	4	1	..	102	25	282	63	Hammersmith.
13	2	9	4	11	..	4	4	10	5	4	1	129	26	332	75	Paddington.
21	7	11	2	6	..	11	..	7	2	1	1	146	29	380	68	Chelsea.
11	..	11	3	9	3	10	3	5	1	2	..	128	24	282	52	St. George, Hanover Sq.*
6	3	6	1	5	2	2	1	3	1	2	..	69	16	184	30	Westminster.
5	1	2	2	5	1	3	..	3	1	1	..	47	14	79	26	St. James, Westminster.
27	1	23	4	18	1	21	4	8	2	2	1	262	34	611	100	St. Marylebone.
5	3	9	1	6	3	5	1	8	..	2	..	98	15	245	35	Hampstead.
29	5	26	1	27	6	19	3	17	4	7	1	393	73	1,007	164	St. Pancras.
37	6	42	6	48	6	44	6	24	10	5	1	542	83	1,280	205	Islington.
45	10	48	10	32	9	39	5	19	6	4	1	576	110	1,366	230	St. Mary, Stoke Newington. Hackney.
6	..	8	..	9	3	3	1	1	..	1	..	63	11	149	26	St. Giles and St. George, Bloomsbury.
1	..	2	..	5	..	1	..	..	..	..	..	29	2	60	8	St. Martin-in-the-Fields.
2	..	5	..	2	3	1	1	3	2	..	..	46	7	79	18	Strand.†
4	..	4	1	6	..	3	1	3	..	1	..	62	11	153	30	Holborn.‡
5	2	6	1	5	1	9	1	6	1	1	..	103	24	329	55	Clerkenwell.
2	1	4	..	6	1	4	..	2	..	..	..	54	7	168	29	St. Luke, Middlesex.
..	..	3	3	6	..	9	..	9	..	..	..	66	15	149	38	London, City of.§
15	4	16	2	6	1	7	3	3	2	..	..	174	27	544	87	Shoreditch.
16	1	9	..	18	2	12	4	17	4	1	..	246	40	669	106	Bethnal Green.
5	..	4	2	4	1	6	3	6	5	3	..	94	23	256	45	Whitechapel.‖
3	2	10	1	6	..	2	..	5	3	5	..	104	14	225	32	St. George-in-the-East.
13	1	8	1	3	..	6	..	4	..	..	..	105	14	297	43	Limehouse.
16	1	14	5	15	4	10	4	5	3	5	1	185	42	523	98	Mile End Old Town.
34	8	28	7	32	8	19	2	18	3	2	..	439	65	1,192	182	Poplar.
..	..	2	..	2	..	..	..	3	..	1	..	21	1	68	9	St. Saviour, Southwark.
6	..	6	..	3	..	2	2	1	..	1	..	67	10	209	42	St. George, Southwark.
7	..	14	1	7	..	9	1	8	1	2	..	126	21	422	69	Newington.
1	..	..	..	..	..	..	..	5	..	..	..	14	2	34	12	St. Olave, Southwark.
7	..	4	3	8	6	7	2	9	1	1	..	94	25	293	54	Bermondsey.
3	1	4	2	1	..	2	..	1	..	..	..	38	7	177	32	Rotherhithe.
32	1	28	4	44	8	25	5	20	6	5	..	361	53	1,005	158	Lambeth.
22	7	24	3	31	3	17	2	19	5	3	2	259	46	630	107	Battersea.
28	6	16	3	18	3	13	2	9	3	3	..	223	42	594	102	Wandsworth.
13	3	25	1	18	5	24	4	20	4	3	1	309	50	847	150	Camberwell.
18	5	21	3	19	3	24	3	11	3	..	1	274	62	709	138	Greenwich.
10	1	9	..	8	5	9	2	6	4	..	..	99	17	248	46	Lewisham
4	..	5	2	2	2	6	..	3	..	..	..	39	8	134	26	Woolwich.
8	1	4	1	8	3	3	..	5	1	1	..	98	16	436	65	Plumstead. Lee.
2	..	3	..	..	..	..	..	1	..	..	..	16	..	59	..	Port of London.

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§ Including Inner Temple (population, 96).

‖ Including Tower of London (population, 868).

¶ The actual dates of the registration weeks in 1897 have been given as perhaps aiding the reader.

	Sanitary Areas.	Population (1891).	SIMPLE CONTINUED FEVER.											
			Weekly Statement, 1st Quarters, 1893–97.¶											
			1st week, Jan. 9.		2nd week, Jan. 16.		3rd week, Jan. 23.		4th week, Jan. 30.		5th week, Feb. 6.		6th week, Feb. 13.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
	London .. .. (*Administrative County.*)	4,232,118	16	..	8	2	11	5	14	2	10	1	9	..
W. District.	Kensington	166,308	..	..	1	..	1	3	..	1	3	..	1	..
	Fulham	91,639	..	..	..	..	..	..	1	..	..	..	..	..
	Hammersmith	97,239	..	..	2	..	1	..	..	..	..	..	1	..
	Paddington	117,846	1	..	..	..	1	1	..	..	..	..	..	..
	Chelsea	96,253	..	..	..	..	..	..	..	..	..	..	..	..
	St. George, Hanover Sq.* ..	78,599	..	..	..	..	..	1	1	..	..	..	..	..
	Westminster	55,539	..	..	..	..	..	..	..	..	..	..	..	..
	St. James, Westminster ..	24,995	..	..	..	..	..	..	..	..	..	..	..	..
N. District.	St. Marylebone	142,404	..	..	..	..	..	..	..	..	1	1	..	..
	Hampstead	68,416	..	..	..	..	..	..	..	..	..	..	..	..
	St. Pancras	234,379	..	..	..	..	..	..	..	..	..	..	..	..
	Islington	319,143	..	..	..	..	..	..	..	1	..	..	2	..
	St. Mary, Stoke Newington	30,936	2	..	1	..	1	..	2	..	1	..	..	..
	Hackney	198,606												
Central District.	St. Giles and St. George, Bloomsbury.	39,782	..	..	..	..	..	..	..	..	..	..	..	..
	St. Martin-in-the-Fields ..	14,616	..	..	..	..	..	..	..	..	..	..	..	..
	Strand†	25,217	..	..	..	..	..	..	..	..	..	..	..	..
	Holborn‡	34,043	..	..	..	..	..	..	..	..	..	..	..	..
	Clerkenwell	66,216	..	..	..	..	..	..	1	..	..	..	1	..
	St. Luke, Middlesex ..	42,440	..	..	..	..	..	..	..	..	..	..	..	..
	London, City of§	37,583	..	..	..	..	..	..	..	..	..	..	..	..
E. District.	Shoreditch	124,009	..	..	..	..	..	..	..	..	..	..	..	..
	Bethnal Green	129,132	1	..	..	1	..	..	..	..	..	..	..	..
	Whitechapel‖	74,420	..	..	..	..	..	..	..	..	..	..	..	..
	St. George-in-the-East ..	45,795	2	..	..	..	1	..	..	..	..	..	..	..
	Limehouse	57,376	..	..	..	..	..	..	..	..	..	..	..	..
	Mile End Old Town ..	107,592	1	..	..	..	..	.	..	..	..	..	..	..
	Poplar	166,748	3	..	1	..	1	..	1	..	1	..	2	..
S. District.	St. Saviour, Southwark ..	27,177	..	..	..	..	..	..	..	..	..	..	..	..
	St. George, Southwark ..	59,712	..	..	..	..	..	..	..	..	..	..	..	..
	Newington	115,804	..	..	..	..	..	..	..	..	..	..	..	..
	St. Olave, Southwark ..	12,723	..	..	..	..	..	..	..	..	..	..	..	..
	Bermondsey	84,682	..	..	..	..	..	..	..	..	..	..	..	..
	Rotherhithe	39,255	..	..	..	..	..	..	..	..	..	..	..	..
	Lambeth	275,203	1	..	2	..	4	..	4	..	3	..	..	..
	Battersea	150,558	5	..	1	..	..	..	3	..	..	..	..	..
	Wandsworth	156,942	..	..	..	..	..	..	1	..	..	..	2	..
	Camberwell	235,344	..	..	..	..	..	..	..	..	..	..	..	..
	Greenwich	165,413	..	..	..	1	1	..	..	..	..	..	..	..
	Lewisham	92,647	..	..	..	..	..	..	..	..	..	..	..	..
	Woolwich	40,848	..	..	..	..	..	..	..	..	1	..	..	..
	Plumstead	52,436	..	..	..	..	..	..	..	..	..	..	..	..
	Lee	36,103												
	Port of London	..	..	..	..	..	..	..	..	..	..	..	..	..

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* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

SIMPLE CONTINUED FEVER—*continued.*

Weekly Statement, 1st Quarters, 1893–97—*continued.*¶

7th week, Feb. 20.		8th week, Feb. 27.		9th week, Mar. 6.		10th week, Mar. 13.		11th week, Mar. 20.		12th week, Mar. 27.		13th week, April 3.		Totals for 1st Quarters, 1893–97.		Sanitary Areas.
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
7	..	9	4	7	1	9	1	10	..	11	..	8	2	129	18	London. (*Administrative County.*)
..	.	1	1	..	..	1	..	..	..	..	..	1	..	9	5	Kensington.
..	..	..	..	..	..	1	..	8	..	..	..	..	..	5	..	Fulham.
..	..	..	..	..	..	..	..	..	..	1	..	..	..	5	..	Hammersmith.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	1	Paddington.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Chelsea.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	St. George, Hanover Sq.*
..	..	..	..	..		..	..	..	..	..	..	1	..	1	..	Westminster.
..	..	1	..	..	..	..	..	..	..	..	..	..	1	1	1	St. James, Westminster.
..	..	..	1	1	..	..	..	..	..	..	..	..	..	2	2	St. Marylebone.
..	..	..	..	1	1	..	..	..	..	..	..	..	..	1	1	Hampstead.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Pancras.
2	..	2	..	1	..	1	1	1	..	1	..	1	..	11	2	Islington.
1	..	..	.	..	..	..	..	..	..	1	..	..	..	9	..	St.Mary,StokeNewington. Hackney.
..	..	..	..	..	..	..	..	..	..	..	.	..	..	..	..	St. Giles and St. George, Bloomsbury.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Martin-in-the-Fields.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Strand.†
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Holborn.‡
1	..	..	..	..	..	..	..	..	..	..	..	..	..	3	..	Clerkenwell.
1	..	..	..	..	..	..	..	..	..	..	..	.	..	1	..	St. Luke, Middlesex.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	London, City of.§
..	..	..	..	..	..	1	..	..	..	..	..	..	..	1	..	Shoreditch.
..	..	..	1	..	..	..	..	..	..	..	..	..	..	1	2	Bethnal Green.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Whitechapel.‖
..	..	..	..	..	..	..	..	..	..	..	..	..	..	3	..	St. George-in-the-East.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Limehouse.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	Mile End Old Town.
1	..	3	..	..	..	2	..	3	..	2	..	..	..	20	..	Poplar.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Saviour, Southwark.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. George, Southwark.
.	..	..	..	..	..	..	..	.	..	..	..	..	..	..	..	Newington.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Olave, Southwark.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Bermondsey.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Rotherhithe.
1	..	2	..	2	..	2	..	2	..	5	..	5	1	33	1	Lambeth.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	9	..	Battersea.
..	..	..	1	..	..	1	..	1	..	..	..	..	..	5	1	Wandsworth.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Camberwell.
..	..	..	..	1	..	..	..	..	..	..	..	..	..	2	1	Greenwich.
..	..	..	..	..	..	..	..	.	..	..	..	..	..	..	..	Lewisham.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	Woolwich.
..	..	..	..	1	..	..	..	..	..	1	..	..	..	2	..	Plumstead. Lee.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Port of London.

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§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

¶ The actual dates of the registration weeks in 1897 have been given as perhaps aiding the reader.

	Sanitary Areas.	Population (1891).	SIMPLE CONTINUED FEVER—*continued.*											
			Weekly Statement, 2nd Quarters, 1893-97.¶											
			14th week, April 10.		15th week, April 17.		16th week, April 24.		17th week, May 1.		18th week, May 8.		19th week, May 15.	
			Cases.	Deaths.	Cases.	Deaths	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
	London .. .. (*Administrative County.*)	4,232,118	8	1	10	..	13	1	3	1	12	..	7	1
W. District.	Kensington	166,308	..	..	..	..	1	..	..	..	..	..	..	..
	Fulham	91,639	..	..	..	..	..	..	..	..	..	..	..	..
	Hammersmith	97,239	2	..	..	..	..	..	..	..	..	..	..	..
	Paddington	117,846	..	..	..	..	..	..	..	..	..	..	..	..
	Chelsea	96,253	..	..	..	..	..	..	..	1	..	..	..	..
	St. George, Hanover Sq.*..	78,599	..	..	1	..	..	..	..	..	..	..	..	..
	Westminster	55,539	..	..	..	..	..	..	..	..	..	..	..	..
	St. James, Westminster ..	24,995	1	..	..	..	..	..	..	..	1	..	..	..
N. District.	St. Marylebone	142,404	..	..	..	..	1	..	..	..	..	..	..	..
	Hampstead	68,416	..	..	..	..	..	..	..	..	1	..	..	..
	St. Pancras	234,379	..	..	..	..	..	..	..	..	..	..	..	..
	Islington	319,143	2	1	..	..	4	..	..	..	1	..	..	..
	St. Mary, Stoke Newington	30,936	1	..	1	..	..	..	..	..	1	..	..	..
	Hackney	198,606												
Central District.	St. Giles and St. George, Bloomsbury.	39,782	..	..	..	..	..	..	..	..	..	..	..	..
	St. Martin-in-the-Fields..	14,616	..	..	..	..	..	..	..	..	..	..	..	..
	Strand†	25,217	..	..	..	..	..	..	..	..	..	..	..	..
	Holborn‡	34,043	..	..	..	..	..	..	..	..	..	..	..	..
	Clerkenwell	66,216	..	..	..	..	..	..	..	..	..	..	1	..
	St. Luke, Middlesex ..	42,440	..	..	..	..	..	..	..	..	..	..	..	..
	London, City of§	37,583	..	..	..	..	..	..	..	..	..	..	..	..
E. District.	Shoreditch	124,009	1	..	..	..	..	..	..	..	..	..	..	..
	Bethnal Green	129,132	..	..	..	..	..	..	..	..	..	..	..	..
	Whitechapel‖	74,420	..	..	..	..	..	..	..	..	..	..	..	..
	St. George-in-the-East ..	45,795	..	..	..	..	..	..	..	..	..	..	..	..
	Limehouse	57,376	..	..	..	..	..	..	..	..	..	..	..	..
	Mile End Old Town ..	107,592	..	..	..	..	..	..	2	..	..	..	..	..
	Poplar	166,748	..	..	2	..	2	..	..	..	1	..	..	..
S. District.	St. Saviour, Southwark ..	27,177	..	..	..	..	..	..	..	..	..	..	..	..
	St. George, Southwark ..	59,712	..	..	..	..	..	..	..	..	1	..	..	..
	Newington	115,804	..	..	..	..	..	..	..	..	1	..	..	1
	St. Olave, Southwark ..	12,723	..	..	..	..	..	..	..	..	..	..	..	..
	Bermondsey	84,682	..	..	..	..	..	..	..	..	..	..	..	..
	Rotherhithe	39,255	..	..	..	..	..	..	..	..	..	..	..	..
	Lambeth	275,203	1	..	3	..	3	..	1	..	2	..	4	..
	Battersea	150,558	..	..	..	..	1	..	..	..	1	..	1	..
	Wandsworth .. .	156,942	..	..	2	..	..	..	..	..	..	..	1	..
	Camberwell	235,344	..	..	..	..	..	..	..	..	1	..	..	
	Greenwich	165,413	..	..	..	..	1	..	..	..	1	..	..	..
	Lewisham	92,647	..	..	..	..	..	..	..	..	..	..	..	..
	Woolwich	40,848	..	..	1	..	..	1	..	..	..	..	..	..
	Plumstead	52,436	..	..	..	..	..	..	..	..	..	..	..	..
	Lee	36,103												
	Port of London	..	..	..	..	..	..	..	..	..	..	..	..	..

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* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).
‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

SIMPLE CONTINUED FEVER—*continued.*

Weekly Statement, 2nd Quarters, 1893–97—*continued.*¶

20th week, May 22.		21st week, May 29.		22nd week, June 5.		23rd week, June 12.		24th week, June 19.		25th week, June 26.		26th week, July 3.		Totals for 2nd Quarters, 1893–97.		Sanitary Areas.
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
12	2	12	1	7	..	14	1	11	2	15	5	14	3	138	18	London. (*Administrative County.*)
..	..	2	..	1	..	1	..	1	..	..	..	1	..	7	..	Kensington.
4	..	..	..	..	..	..	..	..	..	..	1	..	..	4	1	Fulham.
..	..	..	..	..	..	1	..	1	..	1	..	..	1	5	1	Hammersmith.
..	..	..	..	..	..	1	..	1	..	1	1	..	..	3	1	Paddington.
..	..	..	..	..	..	..	..	1	1	..	1	..	..	1	3	Chelsea.
..	..	1	..	..	..	..	..	1	..	..	..	..	..	3	..	St. George, Hanover Sq.*
..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	1	Westminster.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	St. James, Westminster.
..	..	2	..	..	..	..	..	..	..	1	..	..	..	4	..	St. Marylebone.
..	..	..	..	..	..	1	..	1	..	..	..	..	..	3	..	Hampstead.
..	..	2	..	1	..	..	..	..	..	2	..	..	..	5	..	St. Pancras.
..	..	..	..	..	..	1	..	..	..	..	..	1	..	9	1	Islington.
..	..	..	..	1	..	1	..	..	..	..	..	1	1	6	1	St. Mary, Stoke Newington. Hackney.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Giles and St. George, Bloomsbury.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Martin-in-the-Fields.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Strand.†
..	..	..	..	1	..	..	..	..	..	..	..	..	..	1	..	Holborn.‡
..	..	..	..	..	..	..	..	..	..	1	..	2	..	4	..	Clerkenwell.
..	..	..	..	..	..	..	..	..	..	..	..	1	..	1	..	St. Luke, Middlesex.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	London, City of.§
..	..	..	..	1	..	2	..	..	..	..	..	2	..	6	..	Shoreditch.
2	..	..	..	..	..	..	..	1	..	1	..	..	..	4	..	Bethnal Green.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Whitechapel.‖
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. George-in-the-East.
..	1	..	..	..	..	..	..	..	..	..	..	..	1	..	2	Limehouse.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	Mile End Old Town.
1	..	..	..	1	..	..	..	..	..	..	..	1	..	8	..	Poplar.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Saviour, Southwark.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	St. George, Southwark.
..	..	..	..	..	..	1	..	..	..	..	..	..	..	2	1	Newington.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Olave, Southwark.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Bermondsey.
..	..	..	..	..	..	..	..	..	..	..	..	1	..	1	..	Rotherhithe.
1	..	2	..	1	..	4	..	3	..	5	1	4	..	34	1	Lambeth.
..	..	..	1	..	..	..	..	..	..	..	..	..	..	3	1	Battersea.
1	..	1	..	..	..	..	1	..	..	1	1	..	..	6	2	Wandsworth.
1	..	..	..	..	..	1	..	..	..	2	..	..	..	5	..	Camberwell.
1	..	1	..	..	..	..	..	..	..	..	..	..	..	4	..	Greenwich.
1	..	..	..	..	..	..	..	1	..	..	..	..	..	2	..	Lewisham.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	Woolwich
..	1	1	..	..	..	..	..	..	..	..	..	..	..	1	1	Plumstead. Lee.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Port of London.

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§ Including Inner Temple (population, 86). ‖ Including Tower of London (population, 868).

¶ The actual dates of the registration weeks in 1897 have been given as perhaps aiding the reader.

	Sanitary Areas.	Population (1891).	SIMPLE CONTINUED FEVER—*continued.* Weekly Statement, 3rd Quarters, 1893-97.¶ 27th week, July 10. Cases.	27th week, July 10. Deaths.	28th week, July 17. Cases.	28th week, July 17. Deaths.	29th week, July 24. Cases.	29th week, July 24. Deaths.	30th week, July 31. Cases.	30th week, July 31. Deaths.	31st week, Aug. 7. Cases.	31st week, Aug. 7. Deaths.	32nd week, Aug. 14. Cases.	32nd week, Aug. 14. Deaths.
	London .. .. (*Administrative County.*)	4,232,118	13	..	13	1	14	2	14	1	11	8	16	1
W. District.	Kensington	166,308	..	..	..	..	2	..	..	..	..	..	1	..
	Fulham	91,639	..	..	1	..	1	..	..	.	1	..	2	..
	Hammersmith	97,239	1	..	..	..	..	..	..	..	..	..	..	..
	Paddington	117,846	..	..	..	..	1	..	..	..	..	..	..	..
	Chelsea	96,253	..	..	..	..	..	..	..	..	..	..	..	..
	St. George, Hanover Sq.* ..	78,599	1	..	..	1	1	..	..	..	..	1	1	..
	Westminster	55,539	..	..	..	..	..	..	..	..	..	..	..	..
	St. James, Westminster ..	24,995	..	..	..	..	..	..	..	..	..	..	..	..
N. District.	St. Marylebone	142,404	..	..	..	..	..	..	..	..	..	..	2	..
	Hampstead	68,416	1	..	..	..	1	..	1	..	..	..	..	..
	St. Pancras	234,379	..	..	1	..	..	..	..	..	..	..	..	..
	Islington	319,143	..	..	1	..	..	1	2	..	1	..	..	..
	St. Mary, Stoke Newington	30,936	..	..	..	..	..	..	..	..	..	..	..	..
	Hackney	198,606												
Central District.	St. Giles and St. George, Bloomsbury.	39,782	..	..	..	..	..		..	..	..	..	..	..
	St. Martin-in-the-Fields ..	14,616	..	..	..	..	..	..	..	..	..	..	1	..
	Strand†	25,217	..	..	..	..	..	..	..	..	..	..	..	..
	Holborn‡	34,043	..	..	..	..	..	..	..	..	..	..	..	..
	Clerkenwell	66,216	..	..	..	..	..	..	1	..	..	..	..	..
	St. Luke, Middlesex ..	42,440	..	..	1	..	..	..	..	..	1	..	..	..
	London, City of§	37,583	..	..	..	..	1	..	..	..	..	1	1	..
E. District.	Shoreditch	124,009	1	..	..	..	..	..	..	1	..	..	..	..
	Bethnal Green	129,132	1	..	..	..	1	..		..	1	..	..	..
	Whitechapel‖	74,420	..	..	..	..	..	..	..	..	..	..	..	..
	St. George-in-the-East ..	45,795	..	..	..	..	..	..	..	..	..	..	1	..
	Limehouse	57,376	..	..	..	..	..	..	..	..	..	..	..	..
	Mile End Old Town ..	107,592	..	..	..	..	..	..	..	..	..	..	..	..
	Poplar	166,748	1	..	3	..	..	..	3	..	2	..	1	..
S. District.	St. Saviour, Southwark ..	27,177	..	..	.	..	..	..	..	..	..	..	..	..
	St. George, Southwark ..	59,712	1	..	..	..	..	..	..	..	..	..	1	..
	Newington	115,804	..	..	..	..	..	..	..	..	..	..	..	..
	St. Olave, Southwark ..	12,723	..	..	..	..	..	..	..	..	..	..	..	..
	Bermondsey	84,682	..	..	..	..	..	..	..	..	..	..	..	..
	Rotherhithe	39,255	..	..	..	..	..	..	..	..	..	..	..	..
	Lambeth	275,203	3	..	5	..	4	..	3	..	5	..	3	1
	Battersea	150,558	..	..	..	..	..	1	..	..	..	..	..	..
	Wandsworth	156,942	2	..	1	..	2	..	2	..	..	1	1	..
	Camberwell	235,344	..	..	..	..	..	..	..	..	..	..	1	..
	Greenwich	165,413	..	..	..	..	..	..	..	..	..	..	..	..
	Lewisham	92,647	..	..	..	..	..	..	..	..	..	..	..	..
	Woolwich	40,848	1	..	..	..	..	..	.	..	..	..	..	..
	Plumstead	52,436	..	..	..	..	..	..	2	..	..	..	..	..
	Lee	36,103												
	Port of London	..	..	..	..	..	..	..	..	..	..	..	..	..

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* Including St. Peter's, Westminster (population, 235).

† Including Middle Temple (population, 95).

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

SIMPLE CONTINUED FEVER—*continued.*

Weekly Statement, 3rd Quarters, 1893–97—*continued.*¶														Totals for 3rd Quarters, 1893–97.		Sanitary Areas.
33rd week, Aug. 21.		34th week, Aug. 28.		35th week, Sept. 4.		36th week, Sept. 11.		37th week, Sept. 18.		38th week, Sept. 25.		39th week, Oct. 2.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
17	1	14	..	16	1	10	1	19	..	17	2	11	1	185	14	London. (*Administrative County.*)
..	..	..	..	1	..	1	..	..	..	..	..	..	..	6	1	Kensington.
..	..	1	..	1	..	..	1	1	..	2	1	..	..	9	1	Fulham.
1	..	..	..	..	..	1	..	1	..	..	..	..	..	4	..	Hammersmith.
1	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	Paddington.
..	..	..	..	1	..	..	..	..	..	..	..	..	..	1	..	Chelsea.
1	..	..	..	..	..	..	..	1	..	..	..	..	..	5	2	St. George, Hanover Sq.*
..	..	..	..	1	..	..	..	1	..	..	..	..	..	2	..	Westminster.
..	..	..	..	..	..	..	..	1	..	1	..	..	..	2	..	St. James, Westminster.
1	..	1	..	..	..	..	..	1	..	..	..	..	..	5	..	St. Marylebone.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	3	..	Hampstead.
..	..	4	..	..	..	..	..	1	..	1	..	..	..	7	..	St. Pancras.
..	..	..	..	1	..	1	..	..	..	1	..	..	..	7	1	Islington.
1	..	..	..	1	..	2	..	2	..	..	..	..	..	6	..	St. Mary, Stoke Newington. Hackney.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Giles and St. George, Bloomsbury.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	St. Martin-in-the-Fields.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Strand.†
..	..	..	..	..	..	..	..	..	..	..	..	2	..	2	..	Holborn.‡
..	..	..	..	2	..	..	..	..	..	..	..	..	..	3	..	Clerkenwell.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	St. Luke, Middlesex.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	1	London, City of.§
1	..	1	..	1	..	2	..	..	..	..	..	2	..	8	1	Shoreditch.
1	..	..	..	1	..	..	..	..	..	2	..	1	..	8	..	Bethnal Green.
..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	1	Whitechapel.‖
..	..	1	..	..	..	..	..	..	..	..	..	..	..	2	..	St. George-in-the-East.
..	..	..	..	..	..	..	..	1	..	..	..	..	..	1	..	Limehouse.
1	..	..	..	1	..	..	..	..	..	..	..	..	..	2	..	Mile End Old Town.
5	..	2	..	1	..	..	..	2	..	1	..	2	..	23	..	Poplar.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Saviour, Southwark.
..	..	..	..	..	..	..	..	..	..	..	..	..	1	2	1	St. George, Southwark.
..	..	..	..	..	..	1	..	..	..	..	..	..	..	1	..	Newington.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Olave, Southwark.
1	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	Bermondsey.
1	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	Rotherhithe.
2	1	4	..	3	..	1	..	5	..	7	1	3	..	48	3	Lambeth.
..	..	..	..	..	..	..	..	1	..	..	..	..	..	1	1	Battersea.
..	..	..	..	..	..	..	..	1	..	..	..	..	..	9	1	Wandsworth.
..	..	..	..	..	..	..	..	..	..	2	..	..	..	3	..	Camberwell.
..	..	..	..	1	..	..	..	..	..	..	..	1	..	2	..	Greenwich.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Lewisham.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	Woolwich.
..	..	..	..	..	..	1	..	..	..	..	..	..	..	3	..	Plumstead. Lee.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Port of London.

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§ Including Inner Temple (population, 96).

‖ Including Tower of London (population, 868).

¶ The actual dates of the registration weeks in 1897 have been given as perhaps aiding the reader.

	Sanitary Areas.	Population (1891).	SIMPLE CONTINUED FEVER—*continued.* Weekly Statement, 4th Quarters, 1893-97. ¶ 40th week, Oct. 9.		41st week, Oct. 16.		42nd week, Oct. 23.		43rd week, Oct. 30.		44th week, Nov. 6.		45th week, Nov. 13.		46th week, Nov. 20.		47th week, Nov. 27.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
	London .. .. (*Administrative County.*)	4,232,118	14	..	24	..	21	2	16	3	18	1	15	2	13	..	13	2
W. District.	Kensington	166,308	..	..	1	..	..	..	..	..	3	..	1	..	2	..	..	..
	Fulham	91,639	..	..	..	..	..	..	..	..	1	..	..	..	..	..	1	1
	Hammersmith	97,239	..	..	..	..	1	..	1	1	1	..	..	..	..	..	..	..
	Paddington	117,846	..	..	..	..	1	..	1	..	..	..	..	..	1	..	..	..
	Chelsea	96,253	..	..	1	..	2	1	..	..	..	..	..	..	1	..	..	..
	St. George, Hanover Sq.* ..	78,599	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Westminster	55,539	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..
	St. James, Westminster ..	24,995	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..
N. District.	St. Marylebone	142,404	..	..	1	..	..	..	..	..	1	..	..	..	1	..	..	..
	Hampstead	68,416	..	..	1	..	1	..	1	..	..	..	..	..	..	..	..	..
	St. Pancras	234,379	..	..	1	..	3	..	..	..	..	..	1	..	..	..	..	..
	Islington	319,143	..	..	..	..	1	..	1	..	1	..	..	..	..	..	2	..
	St. Mary, Stoke Newington	30,936	2	..	1	..	2	1	..	..	1	..	..	..	..	..	2	..
	Hackney	198,606																
Central District.	St. Giles and St. George, Bloomsbury.	39,782	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	St. Martin-in-the-Fields ..	14,616	..	..	..	..	..	..	1	..	..	..	1	..	..	..	..	..
	Strand†	25,217	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Holborn‡	34,043	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Clerkenwell	66,216	3	..	1	..	..	..	..	..	1	..	1	..	..	..	..	..
	St. Luke, Middlesex ..	42,440	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..
	London, City of§	37,583	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
E. District.	Shoreditch	124,009	..	..	1	..	..	..	1	..	..	..	..	..	..	..	1	..
	Bethnal Green	129,132	..	..	..	..	1	..	..	..	1	..	..	..	..	..	1	..
	Whitechapel‖	74,420	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	St. George-in-the-East .	45,795	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..
	Limehouse	57,376	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..
	Mile End Old Town ..	107,592	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Poplar	166,748	4	..	5	..	3	..	1	..	2	..	1	1	..	..	..	..
S. District.	St. Saviour, Southwark ..	27,177	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	St. George, Southwark ..	59,712	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..
	Newington	115,804	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	St. Olave, Southwark ..	12,723	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Bermondsey	84,682	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Rotherhithe	39,255	..	..	..	..	..	..	1	..	1	..	1	..	1	..	..	..
	Lambeth	275,203	3	..	3	..	3	..	4	1	3	..	3	..	4	..	4	..
	Battersea	150,558	..	..	..	..	1	..	1	..	..	..	1	..	..	..	..	..
	Wandsworth	156,942	..	..	3	..	2	..	..	..	..	..	..	..	2	..	1	..
	Camberwell	235,344	1	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..
	Greenwich	165,413	..	..	2	..	..	..	..	1	..	..	..	..	..	..	..	1
	Lewisham	92,647	..	..	1	..	..	..	..	..	..	1	1	..	..	..	..	..
	Woolwich	40,848	..	..	..	..	..	..	1	..	1	..	1	1	..	..	..	..
	Plumstead	52,436	..	..	1	..	..	..	..	..	..	..	1	..	..	..	..	..
	Lee	36,103																
	Port of London	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

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* Including St. Peter's, Westminster (population, 235).

† Including Middle Temple (population, 95).

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

SIMPLE CONTINUED FEVER—*continued.*

Weekly Statement, 4th Quarters, 1893-97—*continued.* ¶

48th week, Dec. 4.		49th week, Dec. 11.		50th week, Dec. 18.		51st week, Dec. 25.		52nd week, Jan. 1, 1898.		53rd week—1 year only—in 1896.		Totals for 4th Quarters, 1893-97.		Grand Totals for Years, 1893-97.		Sanitary Areas.
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
28	..	10	2	28	1	9	..	10	1	..	1	219	15	671	65	London. (*Administrative County.*)
2	..	..	..	2	..	2	..	..	..	..	..	13	..	35	6	Kensington.
1	..	..	..	..	..	..	..	..	..	..	..	3	1	21	3	Fulham.
1	..	..	1	2	..	1	..	..	1	..	1	7	4	21	5	Hammersmith.
..	..	..	..	..	..	1	..	..	..	..	..	4	..	11	2	Paddington.
..	..	1	..	..	..	..	..	..	..	..	..	5	1	7	4	Chelsea.
..	..	1	..	..	..	..	..	1	..	..	..	3	..	12	3	St. George, Hanover Sq.*
..	..	..	..	..	..	..	..	..	..	..	..	1	..	4	1	Westminster.
1	..	1	..	..	..	..	..	..	..	..	..	3	..	8	1	St. James, Westminster
..	..	..	..	..	..	..	..	..	..	..	..	3	..	14	2	St. Marylebone.
..	..	..	1	..	..	1	..	..	..	..	..	4	1	11	2	Hampstead.
..	..	..	..	..	..	..	..	1	..	..	..	6	..	18	..	St. Pancras.
..	..	1	..	1	..	..	..	..	..	..	..	7	..	34	4	Islington.
5	..	..	..	1	..	1	..	..	..	..	..	15	1	36	2	St. Mary, Stoke Newington. Hackney.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Giles and St. George, Bloomsbury.
..	..	..	..	..	..	..	..	..	..	..	..	2	..	3	..	St. Martin-in-the-Fields.
1	..	..	..	..	..	..	..	..	..	..	..	1	..	1	..	Strand.†
..	..	..	..	..	..	..	..	..	..	..	..	..	..	3	..	Holborn.‡
..	..	..	..	..	..	..	..	..	..	..	..	6	..	16	..	Clerkenwell.
..	..	..	..	..	..	..	..	..	..	..	..	1	..	5	..	St. Luke, Middlesex.
..	..	..	..	1	..	..	..	..	..	..	..	1	..	3	1	London, City of.§
2	..	..	..	2	..	..	..	..	..	..	..	7	..	22	1	Shoreditch.
..	..	1	..	..	..	..	..	..	..	..	..	4	..	17	2	Bethnal Green.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	Whitechapel.‖
1	..	..	..	..	..	1	..	..	..	..	..	4	..	9	..	St. George-in-the-East.
..	..	..	..	1	..	..	..	..	..	..	..	2	..	3	..	Limehouse.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	5	2	Mile End Old Town.
3	..	..	..	3	..	..	..	2	..	..	..	24	1	75	1	Poplar.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Saviour, Southwark.
..	..	..	..	..	..	..	..	..	..	..	..	1	..	4	1	St. George, Southwark.
1	..	..	..	..	..	..	..	..	..	..	..	1	..	4	1	Newington.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Olave, Southwark.
..	..	..	..	1	..	..	..	..	..	..	..	1	..	2	..	Bermondsey.
1	..	..	..	..	..	..	..	3	..	..	..	8	..	10	..	Rotherhithe.
6	..	4	..	3	1	1	..	2	..	..	..	43	2	158	7	Lambeth.
1	..	..	..	2	..	..	..	..	..	..	..	6	..	19	2	Battersea.
2	..	1	..	6	..	..	..	..	..	..	..	17	..	37	4	Wandsworth.
..	..	..	..	..	..	..	..	..	..	..	..	2	..	10	..	Camberwell.
..	..	..	..	2	..	1	..	1	..	..	..	6	2	14	3	Greenwich.
..	..	..	..	..	..	..	..	..	..	..	..	2	1	4	1	Lewisham.
..	..	..	..	1	..	..	..	..	..	..	..	4	1	7	2	Woolwich.
..	..	..	..	..	..	..	..	..	..	..	..	2	..	8	1	Plumstead. Lee.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Port of London.

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§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).

¶ The actual dates of the registration weeks in 1897 have been given as perhaps aiding the reader.

	Sanitary Areas.	Population (1891).	TYPHUS FEVER. Weekly Statement, 1st Quarters, 1893-97.¶ 1st week, Jan. 9.		2nd week, Jan. 16.		3rd week, Jan. 23.		4th week, Jan. 30.		5th week, Feb. 6.		6th week, Feb. 13.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
	London	4,232,118	1	..	..	..	..	..	1	..	1	..	..	1
	(*Administrative County.*)													
W. District.	Kensington	166,308	..	..	..	..	..	..	..	..	..	..	..	..
	Fulham	91,639	..	..	..	..	..	..	..	..	..	..	..	..
	Hammersmith	97,239	..	..	..	..	..	..	..	..	..	..	..	..
	Paddington	117,846	..	..	..	..	..	..	..	..	..	..	..	..
	Chelsea..	96,253	..	..	..	..	..	..	..	..	..	..	..	..
	St. George, Hanover Sq.* ..	78,599	..	..	..	..	..	..	..	..	..	..	..	..
	Westminster	55,539	..	..	..	..	..	..	..	..	..	..	..	..
	St. James, Westminster ..	24,995	..	..	..	..	..	..	..	..	..	..	..	..
N. District.	St. Marylebone .. .	142,404	..	..	..	..	..	..	1	..	..	..	..	..
	Hampstead	68,416	..	..	..	..	..	..	..	..	..	..	..	..
	St. Pancras	234,379	..	..	..	..	..	..	..	..	..	..	..	..
	Islington	319,143	..	..	..	..	..	..	..	..	..	..	..	..
	St. Mary, Stoke Newington	30,936	..	..	..	..	..	..	..	..	..	..	..	..
	Hackney	198,606												
Central District.	St. Giles and St. George, Bloomsbury.	39,782	..	..	..	..	..	..	..	..	..	..	..	..
	St. Martin-in-the-Fields ..	14,616	..	..	..	..	..	..	..	..	..	..	..	..
	Strand†	26,217	..	..	..	..	..	..	..	..	..	..	..	..
	Holborn‡	34,043	..	..	..	..	..	..	..	..	..	..	..	1
	Clerkenwell	66,216	..	..	..	..	..	..	..	..	..	..	..	..
	St. Luke, Middlesex ..	42,440	..	..	..	..	..	..	..	..	..	..	..	..
	London, City of§	37,583	..	..	..	..	..	..	..	..	..	..	..	..
E. District.	Shoreditch	124,009	..	..	..	..	..	..	..	..	..	..	..	..
	Bethnal Green	129,132	..	..	..	..	..	..	..	..	..	..	..	..
	Whitechapel‖	74,420	..	..	..	..	..	..	..	..	..	..	..	..
	St. George-in-the-East ..	45,795	..	..	..	..	..	..	..	..	..	..	..	..
	Limehouse	57,376	..	..	..	..	..	..	..	..	..	..	..	..
	Mile End Old Town ..	107,592	..	..	..	..	..	..	..	..	..	..	..	..
	Poplar	166,748	..	..	..	..	..	..	..	..	..	..	..	..
S. District.	St. Saviour, Southwark ..	27,177	..	..	..	..	..	..	..	..	..	..	..	..
	St. George, Southwark ..	59,712	..	..	..	..	..	..	..	..	..	..	..	..
	Newington	115,804	..	..	..	..	..	..	..	..	..	..	..	..
	St. Olave, Southwark ..	12,723	..	..	..	..	..	..	..	..	..	..	..	..
	Bermondsey	84,682	1	..	..	..	..	..	..	..	..	..	..	..
	Rotherhithe	39,255	..	..	..	..	..	..	..	..	1	..	..	..
	Lambeth	275,203	..	..	..	..	..	..	..	..	..	..	..	..
	Battersea	150,558	..	..	..	..	..	..	..	..	..	..	..	..
	Wandsworth	156,942	..	..	..	..	..	..	..	..	..	..	..	..
	Camberwell	235,344	..	..	..	..	..	..	..	..	..	..	..	..
	Greenwich	165,413	..	..	..	..	..	..	..	..	..	..	..	..
	Lewisham	92,647	..	..	..	..	..	..	..	..	..	..	..	..
	Woolwich	40,848	..	..	..	..	..	..	..	..	..	..	..	..
	Plumstead	52,436	..	..	..	..	..	..	..	..	..	..	..	..
	Lee	36,103												
	Port of London	..	..	..	..	..	..	..	..	..	..	..	..	..

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* Including St. Peter's, Westminster (population, 235).

† Including Middle Temple (population, 95).

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 138), Staple Inn (population, 21), and Furnival's Inn (population, 121).

TYPHUS FEVER—*continued.*

Weekly Statement, 1st Quarters, 1893-97—*continued.*¶

7th week, Feb. 20.		8th week, Feb. 27.		9th week, Mar. 6.		10th week, Mar. 13.		11th week, Mar. 20.		12th week, Mar. 27.		13th week, April 3.		Totals for 1st Quarters, 1893-97.		Sanitary Areas.
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
2	..	2	1	..	..	2	1	4	..	..	..	1	..	14	3	London. (*Administrative County.*)
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Kensington.
..	..	..	..	..	..	1	..	..	..	..	..	..	..	1	..	Fulham.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Hammersmith
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Paddington.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Chelsea.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. George, Hanover Sq.*
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Westminster.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. James, Westminster.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	St. Marylebone.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Hampstead.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Pancras.
..	..	..	..	..	..	..	1	2	..	..	..	..	..	2	1	Islington.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Mary, Stoke Newington. Hackney.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Giles and St. George, Bloomsbury.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Martin-in-the-Fields.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Strand.†
..	..	..	..	..	..	..	..	1	..	..	..	..	..	1	1	Holborn.‡
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Clerkenwell.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Luke, Middlesex.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	London, City of.§
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Shoreditch.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Bethnal Green.
1	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	Whitechapel.‖
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. George-in-the-East.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Limehouse.
..	..	..	..	..	..	..	..	1	..	..	..	..	..	1	..	Mile End Old Town.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Poplar.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Saviour, Southwark.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. George, Southwark.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Newington.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Olave, Southwark.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	Bermondsey.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	Rotherhithe.
..	..	..	..	..	..	1	..	..	..	..	..	..	..	1	..	Lambeth.
1	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	Battersea.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Wandsworth.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Camberwell.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Greenwich.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Lewisham.
..	..	..	..	..	..	..	..	..	..	..	..	1	..	1	..	Woolwich.
..	..	2	1	..	..	..	..	..	..	..	..	..	..	2	1	Plumstead. Lee.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Port of London.

§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).
¶ The actual dates of the registration weeks in 1897 have been given as perhaps aiding the reader.

	Sanitary Areas.	Population (1891).	Typhus Fever—*continued.* Weekly Statement, 2nd Quarters, 1893-97.¶ 14th week, Apr. 10. Cases.	14th week, Apr. 10. Deaths.	15th week, Apr. 17. Cases.	15th week, Apr. 17. Deaths.	16th week, Apr. 24. Cases.	16th week, Apr. 24. Deaths.	17th week, May 1. Cases.	17th week, May 1. Deaths.	18th week, May 8. Cases.	18th week, May 8. Deaths.	19th week, May 15. Cases.	19th week, May 15. Deaths.
	London (*Administrative County*)	4,232,118	1	..	3	..	..	1	2	..	1	..	2	
W. District.	Kensington	166,308	..	..	..	..	..	..	..	..	..	..	..	..
	Fulham	91,639	..	..	..	..	..	..	..	..	..	..	..	..
	Hammersmith	97,239	..	..	..	..	..	..	..	..	..	..	..	..
	Paddington	117,846	..	..	2	..	..	..	..	..	..	..	..	..
	Chelsea	96,253	..	..	..	..	..	..	..	..	..	..	1	..
	St. George, Hanover Sq.*	78,599	..	..	..	..	..	..	..	..	..	..	..	..
	Westminster	55,539	..	..	..	..	..	..	..	..	..	..	..	..
	St. James, Westminster	24,995	..	..	..	..	..	..	..	..	..	..	..	..
N. District.	St. Marylebone	142,404	..	..	..	..	..	..	..	..	1	..	..	..
	Hampstead	68,416	..	..	..	..	..	..	..	..	..	..	..	..
	St. Pancras	234,379	..	..	..	..	..	1	..	..	..	..	..	..
	Islington	319,143	..	..	..	..	..	..	..	..	..	..	..	..
	St. Mary, Stoke Newington	30,936	..	..	..	..	..	..	..	..	..	..	..	..
	Hackney	198,606												
Central District.	St. Giles and St. George, Bloomsbury.	39,782	..	..	..	..	..	..	..	..	..	..	..	..
	St. Martin-in-the-Fields	14,616	..	..	..	..	..	..	..	..	..	..	..	..
	Strand†	25,217	..	..	..	..	..	..	..	..	..	..	..	..
	Holborn‡	34,043	..	..	..	..	..	..	..	..	..	..	..	..
	Clerkenwell	66,216	..	..	..	..	..	..	..	..	..	..	..	..
	St. Luke, Middlesex	42,440	..	..	..	..	..	..	..	..	..	..	..	..
	London, City of§	37,588	..	..	..	..	..	..	..	..	..	..	..	..
E. District.	Shoreditch	124,009	..	..	..	..	..	..	..	..	..	..	..	..
	Bethnal Green	129,132	..	..	1	..	..	..	..	..	..	..	..	..
	Whitechapel‖	74,420	..	..	..	..	..	..	..	..	..	..	..	..
	St. George-in the-East	45,795	..	..	..	..	..	..	..	..	..	..	..	..
	Limehouse	57,376	..	..	..	..	..	..	..	..	..	..	..	..
	Mile End Old Town	107,592	..	..	..	..	..	..	..	..	..	..	..	..
	Poplar	166,748	..	..	..	..	..	..	..	..	..	..	..	..
S. District.	St. Saviour, Southwark	27,177	..	..	..	..	..	..	..	..	..	..	..	..
	St. George, Southwark	59,712	..	..	..	..	..	..	..	..	..	..	..	..
	Newington	115,804	..	..	..	..	..	..	..	..	..	..	..	..
	St. Olave, Southwark	12,723	..	..	..	..	..	..	..	..	..	..	..	..
	Bermondsey	84,682	..	..	..	..	..	..	..	..	..	..	1	1
	Rotherhithe	39,255	..	..	..	..	..	..	..	..	..	..	..	..
	Lambeth	275,203	1	..	..	..	..	..	..	..	..	..	..	..
	Battersea	150,558	..	..	..	..	..	..	..	..	..	..	..	..
	Wandsworth	156,942	..	..	..	..	..	..	..	..	..	..	..	..
	Camberwell	235,344	..	..	..	..	..	..	..	..	..	..	..	..
	Greenwich	165,413	..	..	..	..	..	..	2	..	..	..	..	..
	Lewisham	92,647	..	..	..	..	..	..	..	..	..	..	..	..
	Woolwich	40,848	..	..	..	..	..	..	..	..	..	..	..	..
	Plumstead	52,436	..	..	..	..	..	..	..	..	..	..	..	..
	Lee	36,103												
	Port of London	..	..	..	..	..	..	..	..	..	..	..	..	..

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* Including St. Peter's, Westminster (population, 235).

† Including Middle Temple (population, 95).

‡ Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

Typhus Fever—*continued.*																
Weekly Statement, 2nd Quarters, 1893-97—*continued.*¶														Totals for 2nd Quarters, 1893-97.		Sanitary Areas.
20th week, May 22.		21st week, May 29.		22nd week, June 5.		23rd week, June 12.		24th week, June 19.		25th week, June 26.		26th week, July 3.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
2	..	2	2	1	1	..	1	1	..	3	..	2	..	20	6	London. *(Administrative County.)*
..	..	1	..	..	..	..	..	..	..	..	..	..	..	1	..	Kensington.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Fulham.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Hammersmith.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	Paddington.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	Chelsea.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. George, Hanover Sq.*
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Westminster.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. James, Westminster.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	St. Marylebone.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Hampstead.
1	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	St. Pancras.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Islington.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Mary, Stoke Newington. Hackney.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Giles and St. George, Bloomsbury.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Martin-in-the-Fields.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Strand.†
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Holborn.‡
..	..	..	..	..	..	..	1	1	..	..	..	..	..	1	1	Clerkenwell.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Luke, Middlesex.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	London, City of.§
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Shoreditch.
..	..	..	..	..	..	..	..	..	..	1	..	..	..	2	..	Bethnal Green.
1	..	..	..	..	..	..	..	..	..	1	..	..	..	2	..	Whitechapel.‖
..	..	..	..	..	..	..	..	..	..	1	..	..	..	1	..	St. George-in-the-East.
..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	1	Limehouse.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Mile End Old Town.
..	..	1	1	..	..	..	..	..	..	..	..	1	..	2	1	Poplar.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Saviour, Southwark.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. George, Southwark.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Newington.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Olave, Southwark.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	Bermondsey.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Rotherhithe.
..	..	..	..	1	1	..	..	..	..	..	..	1	..	3	1	Lambeth.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Battersea.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Wandsworth.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Camberwell.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	Greenwich.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Lewisham.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Woolwich.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Plumstead. Lee.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Port of London.

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§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).
¶ The actual dates of the registration weeks in 1897 have been given as perhaps aiding the reader.

	Sanitary Areas.	Population (1891).	TYPHUS FEVER—*continued.* Weekly Statement, 3rd Quarters, 1893-97.¶ 27th week, July 10. Cases.	27th week, July 10. Deaths.	28th week, July 17. Cases.	28th week, July 17. Deaths.	29th week, July 24. Cases.	29th week, July 24. Deaths.	30th week, July 31. Cases.	30th week, July 31. Deaths.	31st week, Aug. 7. Cases.	31st week, Aug. 7. Deaths.	32nd week, Aug. 14. Cases.	32nd week, Aug. 14. Deaths.
	London .. .. (*Administrative County*)	4,232,118	3	..	2	2	2	1	2	1	1	1	4	..
W. District.	**Kensington**	166,308	..	..	..	..	..	..	..	..	..	..	..	..
	Fulham	91,639	..	..	..	..	..	..	..	..	..	..	..	..
	Hammersmith	97,239	..	..	..	..	1	1	..	..	..	..	..	..
	Paddington	117,848	..	..	..	..	..	..	..	..	..	..	..	..
	Chelsea	96,253	..	..	..	..	..	..	..	..	..	..	..	..
	St. George, Hanover Sq.* ..	78,599	..	..	..	..	..	..	..	..	..	..	..	..
	Westminster	55,539	..	..	..	..	..	..	..	..	..	..	..	..
	St. James, Westminster ..	24,995	..	..	..	..	..	..	..	..	..	..	..	..
N. District.	**St. Marylebone**	142,404	..	..	..	..	..	..	..	..	..	..	..	..
	Hampstead	68,416	..	..	..	..	..	..	..	..	..	..	..	..
	St. Pancras	234,379	..	..	..	..	..	..	..	..	..	..	..	..
	Islington	319,143	..	..	..	..	..	..	..	..	..	..	..	..
	St. Mary, Stoke Newington	30,936	..	..	..	..	..	..	..	..	..	..	..	..
	Hackney	198,606		..	..	..	..	..	..	..	..	..	..	..
Central District.	**St. Giles and St. George, Bloomsbury.**	39,782	..	..	..	..	..	..	..	..	..	..	..	..
	St. Martin-in-the-Fields ..	14,616	..	..	..	..	..	..	..	..	..	..	..	..
	Strand†	25,217	..	..	..	..	..	..	..	..	..	..	..	..
	Holborn‡	34,043	..	..	..	..	..	..	..	..	..	..	..	..
	Clerkenwell	66,216	..	..	..	1	..	..	..	..	..	..	..	..
	St. Luke, Middlesex ..	42,440	..	..	..	..	..	..	..	..	..	..	..	..
	London, City of§	37,583	..	..	..	..	..	..	..	..	..	..	1	..
E. District.	**Shoreditch**	124,009	..	..	..	1	..	..	..	..	..	..	..	..
	Bethnal Green	129,132	..	..	..	..	..	..	..	..	..	..	..	..
	Whitechapel‖	74,420	..	..	..	..	..	..	..	..	..	..	..	..
	St. George-in-the-East ..	45,795	..	..	..	..	..	..	..	..	..	..	..	..
	Limehouse	57,376	..	..	1	..	..	..	..	..	..	..	..	..
	Mile End Old Town ..	107,592	..	..	..	..	..	..	..	..	..	..	..	..
	Poplar	166,748	..	..	..	..	..	..	..	..	..	..	..	..
S District.	**St. Saviour, Southwark** ..	27,177	..	..	..	..	..	..	..	..	..	..	..	..
	St. George, Southwark ..	59,712	..	..	..	..	..	..	1	..	..	..	..	..
	Newington	115,804	..	..	..	..	..	..	..	..	..	..	..	..
	St. Olave, Southwark ..	12,723	..	..	..	..	..	..	..	..	..	..	..	..
	Bermondsey	84,682	..	..	..	..	..	..	..	..	..	..	..	..
	Rotherhithe	39,255	..	..	..	..	..	..	..	..	..	..	..	..
	Lambeth	275,203	..	..	..	..	1	..	..	..	1	1	2	..
	Battersea	150,558	..	..	..	..	..	..	..	..	..	..	1	..
	Wandsworth	156,942	..	..	..	..	..	..	..	..	..	..	..	..
	Camberwell	235,344	3	..	1	..	..	..	1	1	..	..	..	..
	Greenwich	165,413	..	..	..	..	..	..	..	..	..	..	..	..
	Lewisham	92,647	..	..	..	..	..	..	..	..	..	..	..	..
	Woolwich	40,848	..	..	..	..	..	..	..	..	..	..	..	..
	Plumstead	52,436	..	..	..	..	..	..	..	..	..	..	..	..
	Lee	36,108		..	..	..	..	..	..	..	..	..	..	..
	Port of London	..	..	..	..	..	..	..	..	..	..	..	..	..

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* Including St. Peter's, Westminster (population, 236).
† Including Middle Temple (population, 95).
‡ Including Gray's Inn (population. 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

Typhus Fever—*continued.*																
Weekly Statement, 3rd Quarters, 1893-97—*continued.*¶														Totals for 3rd Quarters, 1893-97.		Sanitary Areas.
33rd week, Aug. 21.		34th week, Aug. 28.		35th week, Sept. 4.		36th week, Sept. 11.		37th week, Sept. 18.		38th week, Sept. 25.		39th week, Oct. 2.				
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
..	..	..	1	1	1	..	..	1	..	3	1	..	..	19	8	**London.**
																(*Administrative County.*)
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Kensington.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Fulham.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	Hammersmith.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Paddington.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Chelsea.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. George, Hanover Sq.*
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Westminster.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. James, Westminster.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Marylebone.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Hampstead.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Pancras.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Islington.
..	..	..	1	1	1	..	..	..	..	..	..	..	..	1	2	St. Mary, Stoke Newington.
																Hackney.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Giles and St. George Bloomsbury.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Martin-in-the-Fields.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Strand.†
..	..	..	..	..	..	..	..	..	..	1	..	..	..	1	..	Holborn.‡
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	Clerkenwell.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Luke, Middlesex.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	London, City of.§
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	Shoreditch.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Bethnal Green.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Whitechapel.‖
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. George-in-the-East.
..	..	..	..	..	..	..	..	..	..	2	..	..	..	3	..	Limehouse.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Mile End Old Town.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Poplar.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Saviour, Southwark.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	St. George, Southwark.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Newington.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Olave, Southwark.
..	..	..	..	..	..	..	..	1	..	..	1	..	..	1	1	Bermondsey.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Rotherhithe.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	4	1	Lambeth.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	Battersea.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Wandsworth.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	5	1	Camberwell.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	[illegible]h.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	[illegible]n.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	[illegible]
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	[illegible]d.
																[illegible]
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Port of London.

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§ Including Inner Temple (population, 96). ‖ Including Tower of London (population, 868).
¶ The actual dates of the registration weeks in 1897 have been given as perhaps aiding the reader

	Sanitary Areas.	Population (1891).	TYPHUS FEVER - *continued.*															
			Weekly Statement, 4th Quarters, 1893-97.¶															
			40th week, Oct. 9.		41st week, Oct. 16.		42nd week, Oct. 23.		43rd week, Oct. 30.		44th week, Nov. 6.*		45th week, Nov. 13.		46th week, Nov. 20.		47th week, Nov. 27.	
			Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
	London (*Administrative County*)	4,232,118	1	..	2	..	3	2	..	..	3	1	3	..	2	..	2	1
W. District.	**Kensington**	166,308	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..
	Fulham	91,639	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Hammersmith	97,239	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Paddington	117,846	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Chelsea	96,253	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	St. George, Hanover Sq.*	78,599	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Westminster	55,539	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	St. James, Westminster	24,995	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
N. District.	**St. Marylebone**	142,404	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..
	Hampstead	68,416	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..
	St. Pancras	234,379	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Islington	319,143	1	..	1	..	1	..	..	..	..	..	..	..	..	..	1	1
	St. Mary, Stoke Newington	30,936	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Hackney	198,606																
Central District.	**St. Giles and St. George, Bloomsbury.**	39,782	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..
	St. Martin-in-the-Fields	14,616	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Strand†	25,217	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Holborn‡	34,043	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Clerkenwell	66,216	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	St. Luke, Middlesex	42,440	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	London, City of§	37,583	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
E. District.	**Shoreditch**	124,009	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Bethnal Green	129,132	..	..	..	..	1	1	..	..	..	..	..	..	..	..	..	..
	Whitechapel‖	74,420	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	St. George-in-the-East	45,795	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Limehouse	57,376	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Mile End Old Town	107,592	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Poplar	166,748	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
S. District.	**St. Saviour, Southwark**	27,177	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	St. George, Southwark	59,712	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..
	Newington	115,804	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	St. Olave, Southwark	12,723	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Bermondsey	84,682	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Rotherhithe	39,255	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..
	Lambeth	275,203	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Battersea	150,558	..	..	1	..	1	1	..	..	..	..	1	..	..	..	..	..
	Wandsworth	156,942	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Camberwell	235,344	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Greenwich	165,413	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Lewisham	92,647	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Woolwich	40,848	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Plumstead	52,436	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	Lee	36,103																
	Port of London	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..

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* Including St. Peter's, Westminster (population, 235). † Including Middle Temple (population, 95).
Including Gray's Inn (population, 253), Lincoln's Inn (population, 27), Charterhouse (population, 136), Staple Inn (population, 21), and Furnival's Inn (population, 121).

TYPHUS FEVER—*continued.*

Weekly Statement, 4th Quarters, 1893-97—*continued.*¶

48th week, Dec. 4.		49th week, Dec. 11.		50th week, Dec. 18.		51st week, Dec. 25.		52nd week, Jan. 1, 1898.		53rd week—1 year only—in 1896.		Totals for 4th Quarters, 1893-97.		Grand Totals for Years, 1893-97.		Sanitary Areas.
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
1	..	..	..	..	..	1	..	2	..	..	..	20	4	73	21	London. (*Administrative County.*)
..	..	..	..	..	..	..	..	..	..	..	..	1	..	2	..	Kensington.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	Fulham.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	Hammersmith.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	Paddington.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	Chelsea.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. George, Hanover Sq.*
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Westminster.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. James, Westminster.
..	..	..	..	..	..	..	..	..	..	..	..	1	..	3	..	St. Marylebone.
..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1	Hampstead.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	St. Pancras.
..	..	..	..	..	..	..	..	..	..	..	..	4	1	6	2	Islington.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	2	St. Mary, Stoke Newington. Hackney.
..	..	..	..	..	..	..	..	..	..	..	..	2	..	2	..	St. Giles and St. George, Bloomsbury.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Martin-in-the-Fields.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Strand.†
..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	1	Holborn.‡
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	2	Clerkenwell.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Luke, Middlesex.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	London, City of.§
1	..	..	..	..	..	..	..	..	..	..	..	1	..	1	1	Shoreditch.
..	..	..	..	..	..	..	..	..	..	..	..	1	1	3	1	Bethnal Green.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	3	..	Whitechapel.‖
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	St. George-in-the-East.
..	..	..	..	..	..	..	..	1	..	..	..	1	..	4	1	Limehouse.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	Mile End Old Town.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	1	Poplar.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Saviour, Southwark.
..	..	..	..	..	..	..	..	..	..	..	..	1	..	2	..	St. George, Southwark.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Newington.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	St. Olave, Southwark.
..	..	..	..	..	..	..	..	1	..	..	..	1	..	4	2	Bermondsey.
..	..	..	..	..	..	1	..	..	..	..	..	3	..	4	..	Rotherhithe.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	8	2	Lambeth.
..	..	..	..	..	..	..	..	..	..	..	..	3	1	5	1	Battersea.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Wandsworth.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	5	1	Camberwell.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	Greenwich.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Lewisham.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	Woolwich.
..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	1	Plumstead. Lee.
..	..	..	..	..	..	..	..	..	..	..	..	1	..	1	..	Port of London.

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§ Including Inner Temple (population, 96).

‖ Including Tower of London (population, 868).

¶ The actual dates of the registration weeks in 1897 have been given as perhaps aiding the reader.

No. 14.

App. A, No. 14.

The progress and diffusion of Plague in 1899; by Dr. Bruce Low.

SUMMARY of the PROGRESS and DIFFUSION of PLAGUE in 1899; by DR. BRUCE LOW.

In the Medical Officer's Annual Report for last year* a short account was given showing the progress and diffusion of plague throughout the world from 1879 to 1898, as far at least as record of manifestations of the disease could be obtained. In the present annual report this record was to have been continued; but owing to the fact that the wide diffusion of plague during 1899 has involved so many countries and localities, it was found that a brief account even of each of these plague outbreaks would occupy more space than was available. It was therefore decided to give on the present occasion only a short outline of the course which plague has followed since the last report was drawn up, the fuller details being reserved for a special plague volume, to be issued later on.

During 1898 the chief parts of the world which suffered from plague included China, India, Japan, parts of Asiatic Russia, Arabia, East Africa, and Madagascar. In addition, small groups of cases were reported in a few other places, as, for example, at Vienna, where, as will be remembered, three deaths took place at the General Hospital, in connection with laboratory experiments carried on there. But in 1899 the malady began to exhibit a wider distribution. Not only did already infected districts suffer from renewed outbreaks of plague, but other countries which had hitherto escaped now became affected, and at the time of writing bubonic plague may be said to have appeared in all quarters of the globe, attacking localities in Asia, Africa, Europe, Australia, and America, both North and South.

CHINA.

This country, long known as an endemic centre of plague, still continued to suffer from the epidemic manifestations of the disease in 1899.

Hong Kong once again was the scene of an outbreak. From the beginning of 1894, this colony has never been free from the malady, as will be seen from the appended Table I.

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* *See* 28th Annual Report of the Medical Officer to the Local Government Board for 1898–99, pages 199 to 258.

App. A, No. 14.

The progress and diffusion of Plague in 1899; by Dr. Bruce Low

TABLE I.—Showing reported plague cases and deaths in Hong Kong from 1894 to 1899 inclusive.

—	Reported plague cases.	Reported plague deaths.	Case mortality per cent.
1894	2,833	2,550	90·0
1895	45	36	80·0
1896	1,204	1,078	89·5
1897	21	18	85·7
1898	1,320	1,175	89·0
1899	1,486	1,415	95·2
Total in 6 years	6,909	6,272	90·7

In 1900 Hong Kong suffered more heavily from plague than in any year since 1894.

Among other places in China invaded by plague in 1899 may be mentioned *Wo-chow*, *Pakhoi*, *Macao*, *Amoy*, *Swatow*, and *Foochow*. In addition, Northern China became affected and a considerable development of the malady occurred in *Manchuria*, and especially in the town of *New-Chwang*, where it was estimated that at least 2,000 deaths were due to plague during the year. Several localities in *Mongolia* suffered from outbreaks of the disease, and it is asserted by some travellers that the malady is endemic in these districts. As in previous years, the details of outbreaks of plague in China, except in places like Hong Kong, were not easy to obtain, the Chinese methods of reporting and registration being most unsatisfactory.

JAPAN.

In Japan there were no outbreaks on a large scale, but at various ports small groups of cases occurred where infection had been imported from certain Chinese coast towns, chiefly from Hong Kong. *Kobe* and *Osaka* for instance suffered in this way from imported plague.

In the Island of *Formosa* there was a considerable prevalence of plague during 1899. An official statement issued by the Japanese Government shows that 2,633 cases and 1,974 deaths from plague came under observation there during the year. At the beginning of 1900 the malady was again threatening to become epidemic.

THE PHILIPPINE ISLANDS.

Towards the latter part of 1899 plague appeared in *Manila*, and continued to manifest itself during the earlier months of 1900. The facts of this outbreak have not yet been ascertained with any degree of accuracy, but it is asserted by one authority that 190 cases and 132 deaths were certified from plague during the outbreak.

THE SANDWICH ISLANDS.

About the middle of 1899 plague was brought, on board ship, to *Honolulu* from China, but it was not till November that the disease was observed to spread. The information as yet obtainable is not complete, but some 80 cases are said to have come under observation, and of these 62 proved fatal. The Islands of *Kahului*, and *Hilo*, also in the Sandwich group, yielded a few cases.

NEW CALEDONIA.

In December, 1899, *Numea* was attacked by plague. Some difficulty has been experienced in securing accurate information as to this outbreak, which extended into the early months of 1900. One report states that some 238 plague deaths had been recorded, but it was admitted that this must be far short of the actual amount. The first persons attacked were among Kanaks and Tonkinese labourers. Early in 1900 the disease attacked the convicts working in the nickel mines at *Neponi*, on the West Coast.

AUSTRALIA.

About the end of 1899 and beginning of 1900 sporadic cases of plague were recognised at *Adelaide*, in *South Australia*, but the disease did not assume epidemic proportions.

About the same time cases began to appear at *Sydney*, in *New South Wales*, and, up to about the middle of 1900, 303 cases and 103 deaths had been certified from the disease, a case mortality of 34 per cent. About the beginning of 1900 a few cases occurred in the colony of *Victoria*, at *Melbourne*, but there was no epidemic. Also about this time *Queensland* became infected, plague appearing in succession at *Brisbane*, *Rockhampton*, *Townsville*, *Cairns*, and *Ipswich*. Altogether about 123 cases and 53 deaths have been reported in Queensland. *Western Australia* also yielded a few sporadic cases in the early part of 1900, at *Freemantle*, *Perth*, and *Coolgardie*.

It is evident from the fact that the five chief divisions of the Australian Continent were invaded that plague had become somewhat widely diffused there, and its recurrence may be expected sooner or later in one or another of these places.

NEW ZEALAND.

A single case of plague was reported at *Auckland* in the spring of 1900, the infection having in all probability been conveyed from Sydney. But it is stated that previous to this man's attack, rats on the wharves were found to be infected by plague; it was also alleged that the sufferer had been bitten by a rat prior to his illness.

STRAITS SETTLEMENTS.

Penang.—At the beginning of May, 1899, plague appeared here, and during the next few weeks 49 cases and 37 deaths from plague had been recorded within the municipal limits of Penang. With the exception of a few Malays, all the victims were Chinese. No Europeans or Eurasians were attacked. The infection is believed to have come from Southern China. It is known that just before the outbreak 1,500 Chinese coolies had been landed.

Singapore.—A number of separate cases, amounting together to 10, were landed by ships from Hong Kong at *Singapore* during 1899. The disease, however, did not become epidemic.

INDIA.

In the *City of Bombay*, where epidemic plague was first recognised in 1896, the disease has continued to rage in spite of the measures employed to check it, but with certain regular remissions during the summer seasons. The subjoined table gives a summary of the cases reported and deaths certified from plague since its appearance in the city to the end of 1899.

TABLE II.—Showing reported plague cases and deaths and the case mortality in the City of Bombay for each of the years 1896 to 1899 inclusive.

Year.	Plague Cases Reported.	Plague Deaths Certified.	Case Mortality per cent.
1896	2,530	1,801	71·1
1897	11,963	10,232	85·7
1898	19,863	18,160	91·2
1899	19,484	15,830	81·3
Totals ...	53,840	46,023	85·4

In the early part of 1900 the disease was again epidemic.

During each year the incidence of plague has reached its height in March and has been lowest during June and July.

In the *Presidency of Bombay* plague has continued its ravages during 1899. During 1896 the figures representing cases and deaths were comparatively small, but in 1897 they rose rapidly, increasing to a further height in 1898. The figures obtainable for 1899 show that 131,794 cases were reported, and that of these 101,485 proved fatal. It is stated that for the period comprised between September, 1896, and December, 1899, the total plague cases in the Bombay Presidency, not including the City of Bombay, amounted to 271,792 and that the deaths were 206,526.

The following Table III. gives approximately the number of cases and deaths from plague in the Bombay Presidency, not including the City of Bombay, during the period 1896 to 1899.

TABLE III.—Showing the number of reported cases and deaths and the case mortality in the Bombay Presidency, NOT including the City of Bombay, for each of the 4 years 1896 to 1899.

Year.	Plague Cases.	Plague Deaths.	Case Mortality per cent.
1896	367	273	74·3
1897	49,125	36,707	74·7
1898	90,506	68,061	75·2
1899	131,794	101,485	77·0
Totals ...	271,792	206,526	75·8

APP. A, No. 14.

The progress and diffusion of Plague in 1899; by Dr. Bruce Low.

The districts of this Presidency which suffered most heavily during 1899 were Belgaum, Dharwar, Karachi, Kholapur, Poona, Satara, Surat, Thana, Nasik, and Bijapur.

In 1900 plague was again epidemic in the Presidency.

In *Poona City* there was another severe outbreak in 1899, and this reached its height in August. During the five weeks ended September 1st no fewer than 5,316 plague deaths were recorded. During this epidemic, the fourth experienced since 1897 by the city, upwards of 10,000 persons perished from plague in Poona and its suburbs. The disease was again prevalent during 1900.

In the Town of *Karachi* during 1899 an outbreak, the third that had been experienced, began in February and continued till the beginning of June. During that time 3,119 cases and 2,261 deaths from plague were recorded. A fresh outburst developed during the spring of 1900, and reached its height during April.

Space does not permit further reference to special outbreaks in the Bombay Presidency, but the fact is worth noting that at such places as Bombay, Poona, and Karachi, plague, notwithstanding all efforts, has recurred year by year since its first appearance in 1896. Fuller details of the above and other outbreaks will be furnished in the forthcoming plague volume already referred to.

The City of Calcutta.—During 1899 the total reported plague cases in the city and suburbs amounted to 3,005 and the deaths to 2,745. During 1898 the plague deaths had numbered only 192. For a while it was thought that the conditions of life in Calcutta might prove unfavourable to the development of an epidemic of plague. But this anticipation has not been realized; Calcutta suffered in 1899 and again in 1900 from the disease, the first half of 1900 having yielded no fewer than 7,449 plague deaths. The height of the 1899 outbreak was reached in April, and that of 1900 in March.

The Bengal Presidency.—During 1898 only 16 plague deaths were officially reported from this Presidency outside Calcutta. During 1899 not much, comparatively, was heard of the disease; but outbreaks were reported in the Howrah and Saran and other districts, with smaller groups of cases in one or two others. The totals in the Presidency, excluding Calcutta, were 652 cases and 505 deaths. Towards the end of 1899, however, cases began to be more numerous, and *Patna* became affected. Here a very severe epidemic developed, which attained its maximum at the end of March and beginning of April, 1900, more than 10,000 persons having perished from the disease. During the early months of 1900 plague was diffused somewhat widely throughout the Presidency of Bengal. Next to Patna the chief districts that suffered were Saran and Monghyr. In the Patna district during the first half of 1900 no fewer than 17,674 deaths were certified from plague.

Rajputana.—During 1899 only 20 cases and 17 deaths from plague were notified in Rajputana.

The Punjaub.—During 1899 there were 227 plague deaths certified, 206 of these being referred to the Jullunder district, 17 to Hoshiapur, three to Rawalpindi, and one to Amritsar. The majority of the cases were reported in May and June. During 1898 the plague deaths in the Punjaub had numbered 2,049.

Central Provinces.—In the Nagpur district, during 1899 there were recorded 559 cases and 460 plague deaths, 262 cases and 202 deaths being referred to Nagpur city; at Wardha 73 cases and 65 deaths were reported. These, with scattered cases in other districts, make up a total for the Central Provinces of 638 cases and 526 deaths during the year. The majority of the deaths occurred during September and October. During the first three months of 1900 the disease was epidemic at Nagpur, over 500 deaths being recorded. During 1898 there had been 129 deaths from plague in the Central Provinces, all except four being referred to the Wardha district.

In the Native States of Central India some 7 cases and 6 deaths were certified.

The Madras Presidency.—Plague was epidemic in certain districts of this Presidency, particularly those in communication with the States of Hyderabad and Mysore, where during the early part of 1899 plague was epidemic. During the latter part of the year there was not much recrudescence of the disease, though the districts of Salem, Coimbatore, Bellary, and North Arcot all yielded cases. The total reported cases during 1899 amounted to 2,480, and of these 1,855 proved fatal. Of the above, only 11 cases and 4 deaths were referred to Madras City. In November, 1899, cases again began to develop in a number of districts, but not to any great extent. It is stated that from August, 1898, to the beginning of June, 1900, the plague cases reported in this Presidency numbered 3,811, and the deaths 2,892.

In the Hyderabad State plague was epidemic during the winter of 1898–9, and became epidemic again towards the end of 1899. From January to December, 1899, there had been recorded 5,271 cases and 4,242 deaths from plague. Some 2,000 of these plague deaths occurred after October. The districts which chiefly suffered during 1899 were Linsugur, Naldrug, and Galburga.

Mysore State.—The reported plague cases during 1899 numbered 8,836 and the deaths 6,742. Plague had been epidemic here also during the winter of 1898–99, and up to 1899 the total plague deaths recorded from the first appearance of plague in the State of Mysore in April, 1898, had amounted to 15,597. In the winter of 1899-1900 the disease again reappeared, and from October to January some 1,753 more plague deaths were reported. The chief localities thus infected included Bangalore City and district, Mysore City and district, and the Kholar goldfields.

Assam.—In the Sylhet district during April, 1899, 4 fatal plague cases were reported but no extension seems to have taken place.

Burma.—In Rangoon a single imported case, which proved fatal, occurred in November, 1899.

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Baluchistan.—During May, 1899, 4 plague cases and 3 deaths were reported from the South East frontier; but no epidemic followed.

PERSIA.

During May, 1899, plague appeared at *Bushire*, on the Persian Gulf; and, up to June 18th, 40 cases were reported. Though local accounts state that the disease increased during June and July, no figures have been published giving the number of cases and deaths that followed. By August the outbreak was over. In September the malady broke out at *Jask*, also in the Persian Gulf.

During the early months of 1900 plague became epidemic in the *Jivanro* district of Persian Kurdistan, not far from the Turko-Persian frontier.

MESOPOTAMIA.

In May, 1899, plague was imported into *Bassorah* from Djeddah by returning pilgrims. Only some 4 or 5 recognised cases were reported. But in October the United States Consul wired to his Government information as to the reappearance of plague at Bassorah. Later accounts stated that an epidemic of either plague or cholera was appearing on both banks of the Shatt-el-Arab, from Bassorah to Fao.

ARABIA.

Muscat, in the Sultanate of Oman, was invaded by plague in April, 1899, the infection having, it is alleged, been brought by sea from Karachi. In November cholera was epidemic in this and adjoining districts, as was also small pox. In January, 1900, plague again appeared and continued to spread during February and March; it is stated that 600 plague deaths were recorded in Muscat in that period.

In *Mattrah*, during 4 weeks ended April 21st, 1900, 230 plague deaths were reported. By June plague had seemingly disappeared from the Sultanate of Oman.

Aden.—Early in 1900 a sharp outburst of plague occurred at Aden. From February to June 714 cases were reported, and of these 575 proved fatal—a case mortality of 80·5 per cent. The disease first broke out at the Hedjaz wharf, where large quantities of grain are unloaded. From Aden plague was carried by refugees to *Berbera*, in *British Somaliland*, on the opposite African coast. But only 2 fatal cases were recorded among the many refugee coolies from Aden who were kept under observation at the Berbera sanitary station before being allowed to enter the Protectorate.

Assyr.—In 1899, as in many previous years, plague appeared in Assyr, a locality now regarded as one of the "plague" endemic areas of the world. The later months of the year are those in which plague regularly reappears in this district, from which, however, few official facts are allowed to issue. It is known that Confouda, one of the Assyr ports, was infected at the end of 1899; Ben Sheïr, a locality in which repeated outbreaks have been reported, also suffered. In the early part of 1900 several villages were decimated by the disease. This district of Assyr, owing to its relations to the Hedjaz, and since many pilgrims pass through it on their way to Mecca from the south, must be regarded as a continual source of danger to the pilgrimage, and through this to the outer world.

Djeddah is the chief port of the Hedjaz, and during the years 1896, 1897, and 1898 was infected by plague. In 1899 it again suffered from an outbreak of the disease, the infection being locally traced to importation from Assyr by pilgrims en route for Mecca. From February to June, 1899, 121 plague deaths were certified. But this does not represent the full amount of the disease, since it is admitted that fatal cases were concealed by relatives, and even ignored by the authorities themselves. Dr. Xanthopoulides, "the Sanitary Inspector," believes that the recorded plague deaths should be trebled to come near the truth. The epidemic began with a so-called influenza outbreak, which Dr. Xanthopoulides now regards as having been epidemic plague of a mild type. At the beginning of 1900 the disease was again prevalent at Djeddah, 81 deaths having been certified from that cause.

Yambo, another port of the Hedjaz, lies on the east coast of the Red Sea, north of Djeddah, and from it many pilgrims from Medina embark on their return journey to their native country. This port, which is not known to have been invaded by plague in 1899, became infected simultaneously with Djeddah early in 1900, and some 67 plague deaths were reported up to June. Official accounts of the outbreak have not been made public by the Turkish authorities.

Mecca lies some 50 miles east of the port of Djeddah, from which place plague was imported into the "Holy City" and to *Mouna* during the 1899 pilgrimage. But fortunately only four cases occurred and no extension of the disease took place therefrom.

AFRICA.

EGYPT.—*Alexandria.*—In May, 1899, plague was officially recognised as existing in Alexandria. But it is alleged that mild cases, not at the time diagnosed as plague though afterwards believed to have been in all probability instances of that disease, had been occurring since January. The malady never assumed large proportions; for, from the date of its recognition at the beginning of May up to the early part of November (in a population estimated at 319,766), only 93 plague cases were certified, and of these 45 had a fatal termination—a case mortality of 48·4 per cent. The disease did not apparently spread beyond Alexandria into Egypt; but two imported cases were reported from the town of *Damanhour*, situated 40 miles south of Alexandria. Of the 93 cases 65 were natives, 25 Greeks, 2 French, and 1 Italian. Careful investigation failed to discover how and from what source Egypt had in this instance received plague infection; but it is surmised that the disease had been brought from some infected port in India or the far East, or (which is more likely) from some infected port in the Red Sea. In 1900, plague re-appeared in Alexandria in May, after a seeming absence extending over five months. The first cases in 1900 arose among persons associated with a rag-picking business.

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Up to the time of writing, 29 cases and 19 deaths have been certified. The disease, happily, has not shown so far any great tendency to spread; and under the direction of Pinching Bey, successor to Sir John Rogers, as head of the Egyptian Sanitary Service, active measures have been taken to remove conditions likely to promote the diffusion of the infection.

Port Said was declared infected in May, 1900, but cases, now regarded as plague, had been observed as far back as March. Up to July, 89 cases had been certified, of whom 35 died. This cannot be regarded as a very large outbreak, since the population of Port Said is about 42,000.

A single case was reported at *Damietta*, on board a native craft from Port Said, in May, 1900, and during the same month three other cases were observed at *Suakin*.

British East Africa.—A fatal case of plague occurred on board a German steamer which arrived at *Zanzibar* on December 12th, 1899, from Mombassa, the chief port on the mainland of British East Africa. Although a large number of Indian coolies, to be employed on the new Uganda Railway works, arrived from Bombay and other Indian ports during the year at Mombassa, no other cases of plague were reported in 1899. It is known that in *Uganda* there exists an endemic-plague centre not far from (if not on both sides of) the borders of the German Protectorate, but during 1899 no special information was to hand showing that the disease had been markedly manifesting itself there.

German East Africa.—During 1899 there appear to have been fewer outbreaks of plague in German East Africa than in the preceding year. During the first five months of 1899 few plague deaths were officially reported, but the cases became more numerous during the latter part of the year. The territories of the Sultan Leissawula, and of the Sultan Kartassigwa, were invaded. Cases were also reported in German *Buddu*, on the left bank of the Kagera. But no definite figures as to the number of cases and deaths have been obtainable.

Lorenzo Marques.—In December, 1898, a Parsee patient's death was certified here from "galloping consumption." But it is now believed that the man died from unrecognised plague. Other attacks followed, three deaths from plague-like illness occurring in January, 1899. Up to March about 20 cases regarded as plague had been reported, and 15 of them proved fatal. It is believed that the infection was brought by steamer from Madagascar, at that time invaded by plague. Indeed, one of the vessels which trade regularly between Madagascar and Lorenzo Marques is known to have had eight plague cases on board on arrival at the latter port. These persons were refused by the authorities permission to land, and they were consequently conveyed back to Madagascar. No trustworthy reports as to the real number of plague cases and deaths in Lorenzo Marques have been forthcoming, since *the local medical men were forbidden to certify cases as suffering from plague, the Governor-General assuring the foreign consuls that there was no plague in the district.** The

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* *See* Carlos Vaz "A peste em Lorenzo Marques," quoted in the Centralblat für Bacteriologie, &c., February 16th, 1900.

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disease lingered during 1899 in the port, and the last known case was heard of on February 22nd, 1900.

Transvaal.—A Hindoo passenger from Bombay via Lorenzo Marques arrived at Middleburg on February 1st, 1899, and became ill on February 6th with "fever and buboes." He died of the disease; but no further case was reported.

Mozambique.—In the *Magude* district, on the Incomati River, about 60 miles north of Lorenzo Marques, plague appeared in April, 1899. It spread in a number of native villages at that time, but seemingly subsided in the mid-summer months. A recrudesence took place in September, and in consequence a number of native villages were burnt to prevent the spread of the disease. In the *Marracuene* district, which lies a short distance north of Lorenzo Marques, plague appeared in August, 1899, the first recognised sufferer having come from the infected Magude district.

Cape Town.—On March 5th, 1900, the transport *Kilburn*, conveying compressed forage from Rosario, arrived at Cape Town with three cases of plague on board. The captain had died from an unknown disease, presumably plague, on the voyage. The first case fell ill on board three days after leaving Rosario. The ship was sent to the quarantine station at Saldanha Bay. Two other members of the crew were attacked by plague at Saldanha Bay, making six cases (including the captain). It is reported that the Customs officer who boarded the *Kilburn* at Cape Town died not long after from pneumonia, and there were grave suspicions that he had contracted plague in the discharge of his duty. The Port Medical Officer of Health, however, states that the pneumonia in this case was not due to plague.

Grand Bassam, on the French Ivory Coast, West Africa, was reported during May, 1899, to be the scene of a considerable outbreak of bubonic plague. It was stated that in a short space of time from 200 to 300 victims had perished, including three medical men. Some French reports alleged the disease to be yellow fever and not plague. But reports from British residents declared the disease to be undoubtedly bubonic plague. Accounts also sent from the adjacent State of Liberia confirmed the statements as to the presence of plague. No details, however, of the outbreak have as yet been received. A despatch from Monrovia, Liberia, dated September 16th, 1899, announced that bubonic or similar plague "had recently recurred on the French Ivory Coast, east of Liberia."

Algiers.—During September and October, 1899, some suspicious cases, said to resemble plague, occurred at *Philippeville* and at *Bougie*, in the Province of Constantine. Dr. Chantemesse, of Paris, was sent to investigate the cases and to make bacteriological examinations. The results, however, still left the diagnosis in doubt. The outbreak meanwhile subsided, special precautions having been taken to prevent its spread.

MADAGASCAR.

An outbreak of plague occurred in this island at the end of 1898, and continued during the earlier part of 1899; it then appeared to have completely died out. But in September it reappeared at *Tamatave* and neighbourhood. It is admitted that 52 cases and 41 deaths were recorded during a short period. Only one European suffered. Another outbreak, but of small dimensions, was reported in October from the Bay of *Diego Suarez* to the N.E. of the Island. Some cases also were heard of in October at *Andvorante*, which lies 50 miles south of Tamatave.

Réunion.—In April, 1899, cases of so-called "Lymphangite infectieuse" were reported, some practitioners stating that they had difficulty in deciding between this malady and plague. To settle the question Dr. Thiroux, a Colonial Medical Officer at Madagascar, and a former pupil of the Pasteur Institute, was invited to come to Réunion and investigate the cases by bacteriological methods. This he did, and by way of confirming his conclusions he sent specimens of his microscopic preparations and cultures to the Paris Institute, for examination by Dr. Roux. The latter reported that the bacillus contained in Dr. Thiroux's cultures was the true plague bacillus. Dr. Thiroux thus claims to have established the fact that an endemic disease in Réunion known as "Lymphangite infectieuse" is undoubtedly bubonic plague. The precise number of plague cases has not been ascertained, but instances of the disease continued to occur from April to July in the town of *St. Denis*, where, after an interval of about two months, a fresh outbreak occurred in October. By January, 1900, the disease had again apparently subsided.

Mauritius.—Towards the end of 1898 scattered cases of a sort suggestive of plague were observed in *Port Louis*. Bacteriological investigations, undertaken in January, 1899, confirmed the diagnosis of plague; and inquiries showed that plague cases had been without doubt occurring as far back as November, 1898. The outbreak began in Port Louis and extended slowly throughout the other districts of the island. The epidemic reached its height in October, 1899. The total reported cases from December, 1898, to June, 1900, amounted to 1,566, and of these 1,157 proved fatal. But these figures do not reveal the full incidence of the disease; for not only were cases concealed, but fatal cases were reported under other designations. Investigations showed that some fatal cases of pneumonic plague were certified as having died from "bronchitis." The Chinese population systematically concealed their plague cases. From Port Louis, when plague was definitely declared, many persons fled in panic into the adjoining districts, carrying the infection with them. Opinions were divided as to how plague had reached Mauritius. Some thought it had been brought by ship from Tamatave, Bombay, or Hong Kong. Others were inclined to believe that the epidemic had been due to an intensification of an endemic lymphangitis, which, it was suggested, was a mild form of plague, as in Réunion. Some alleged that plague had been present in a mild endemic form in Mauritius since the devastating epidemic which raged in the island from 1866 to 1868. This epidemic was at the time regarded as *malarial fever;* it carried off in about 3 years some 60,000 victims out of a population estimated at about 350,000. Further discussion of this interesting epidemic is reserved for the forthcoming plague volume, to which reference has already been made.

TURKEY.

Beyrout.—In September, 1899, a single fatal plague case occurred at Beyrout, in the hospital, the patient having left Alexandria four days previously apparently in good health. No further cases were noted subsequently until July, 1900, when a group of five cases in one house was discovered.

No other localities in Turkey are known to have been invaded by plague in 1899, but in May, 1900, *Smyrna*, and in June, *Trebizonde*, were declared infected, cases of plague having occurred in each place.

RUSSIA.

Astrachan.—This province, which was the scene of a plague outbreak in 1878–79, was again visited by the disease in 1899. During July and August an epidemic disease characterised by pneumonia appeared at *Kolobovka*, which is situated on the Volga, in the district of Tsarevo. Of 24 cases at first reported 23 had proved fatal. Some dispute as to the nature of the malady arose, and the Russian Government appointed a Commission to settle the question. The majority of the members of this Commission ultimately expressed the opinion that the outbreak had undoubtedly been one of true bubonic plague. The origin of the infection was not definitely ascertained; some alleging that plague was endemic in Astrachan, others that it had been brought by means of rags from Persia or even from Central Asia, or from the Trans Baikal region in Siberia where plague is believed to be endemic among the nomadic tribes.

Following close upon the Kolobovka outbreak, another occurrence of a similar kind appeared in September, 1899, in the district of *Samara*, on the Volga, North of Kolobovka. This outbreak was at first asserted to be one of "malarial fever," attended with pneumonic complications. In November a third outbreak occurred in the district of *Krasnoyarsk*, situated on one of the mouths of the Volga, and not very far from Kolobovka. The people attacked lived on an island. Of this limited population 59 fell victims to the disease in a short period.

AUSTRIA.

Trieste.—A Levantine steamer from Constantinople arrived at Trieste on October 27th, 1899. Her boatswain was suffering from illness thought to be bronchitis, but which was found, on examination after death in hospital, to have been bubonic plague. The diagnosis was confirmed by bacterioscopic examination. The source of this man's illness was not traced. No further cases followed.

Early in December, 1899, an Austrian Lloyd's steamer arrived at Trieste from Santos and Rio de Janeiro, and reported four plague deaths on board during the voyage. No actual cases were found on the ship's arrival, but it was admitted that while at Rio de Janeiro some of the crew had suffered from short feverish attacks attended with prostration, but from which they recovered rapidly.

Fiume.—During November, 1899, a steamer from Constantinople arrived at Fiume with a suspected plague case on board, but no official report confirming this suspicion has been received.

Cracow.—During January, 1900, it was reported that Dr. Kostanecki, assistant at the Cracow Bacteriological Institute, had died, after an illness of two days' duration, with symptoms which led to the opinion that he had contracted plague while working with cultures of the microbe of that disease.

SPAIN.

In October, 1899, some cases of serious illness, suspected to be plague, were reported from *Quero*, near Toledo; but no official confirmation of the suspicion has been received. During November, at *Cadiz*, a dock labourer suffered from fever and buboes, and was removed to an isolation hospital. Bacteriological investigation did not yield positive results confirmatory of the diagnosis of plague. It was mentioned in connection with this case that, on board the ship which this labourer had been unloading, a sailor had died somewhat suddenly from some acute illness, certified as "Meningitis."

PORTUGAL.

Oporto.—Plague was officially declared to exist in Oporto on the 12th of August, 1899. But investigation has since shown that this disease had been prevailing there in June and July, if not earlier. The cases at Oporto now regarded as plague between June, 1899 and February, 1900, are reported to have numbered 310. Of these 114 proved fatal, a case mortality of 36·7 per cent. It is however generally admitted that these figures by no means exhibit the actual amount of plague that occurred in Oporto during 1899; and there can be little question that cases were concealed from the authorities, and that deaths really caused by plague were certified from other causes. The deaths from all causes were much increased in June, the number of actual deaths being nearly double the average number for that month in the two previous years. The excess of deaths from all causes in 1899 over that of the previous year was no less than 845. For some at least of this excess plague is likely to have been responsible.

The Oporto epidemic reached its height in October and finally subsided in the following February. In June, 1900, the occurrence of plague in a mild form was reported in Oporto, but details have not been furnished by the Government, Portugal not being a signatory of the Venice Convention.

It has not been satisfactorily traced how and when plague reached Oporto in the first instance. But among various surmises entertained were:—(1) That infection came by goods shipped from India to England and transhipped thence to Oporto. No facts have been adduced in support of this gratuitous theory. (2) That some grain ship or vessel carrying other cargo arriving from a foreign port brought plague-infected rats, which, having effected a landing, infected the native rats and thus started the epidemic. (3) That

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an English traveller from Bombay who had arrived at Oporto was then ill of the disease, and that persons who waited on him contracted the infection. (4) That the disease had existed in Oporto for some two years, and had been originally brought from Macao, Goa, Lower Damaun, Mozambique, or other infected Portuguese colony by transports bringing home troops; that, in fact, cases had been occurring in Oporto since 1897, a number of them, certified as typhoid fever, having distinct glandular swellings.

From Oporto plague was carried into surrounding villages, and to the town of *Braga*, some 35 miles distant; but there was no epidemic outside the town.

In November plague was reported at *Alpedreno*, a Portuguese village near the Spanish frontier, but no details have been published.

Lisbon.—Professor Camara Pestana, of Lisbon, an expert who had been visiting Oporto, making post-mortem and other examinations of the plague cases there, returned to Lisbon ill with plague, and died of that disease on November 5. He had accidentally infected himself while conducting an autopsy during the previous week. He had been inoculated with Calmette's anti-plague serum a month before his death, but had refused to be re-inoculated, believing himself proof against the infection.

During September, 1899, there was an epidemic in Lisbon called by some persons "the Indian typhoid," but which others suspected to be a mild form of plague. The authorities established a censorship of the press and nothing was allowed to be published as to this epidemic. No details, therefore, are obtainable as to whether this was or was not a plague outbreak.

Early in September a Portuguese gunboat, recently arrived from Africa, landed at Lisbon a sick marine, who died shortly afterwards with symptoms suggestive of plague. Though the officers and crew of the gunboat had to undergo 12 days' quarantine at the Lazaretto, it was not stated whether or not the marine had died of plague. During December a soldier, not long returned from East Africa and who had been away on leave visiting friends in the Oporto district, presented himself at Lisbon for inspection, according to the regulations, on his return. He was found to be suffering from fever and buboes and was isolated as a case of plague. No further information regarding this patient has been obtainable.

NORTH AMERICA.

New York.—On November 18th, 1899, a British steamer arrived at New York quarantine station from Santos, a plague-infected port in Brazil, the officer in charge reporting that the steward had died at sea, on the voyage, from an illness attended with buboes, and believed to be plague. The master and the cook, who had waited on the deceased, were then suffering from a similar illness, and were sent to hospital on Swinburne Island.

Port Townsend.—On January 30th, 1900, a Japanese steamer arrived at Port Townsend, from Kobe and Honolulu, both plague-infected ports. with two cases of illness on board, which was

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regarded at first as beri-beri. One of the patients died at the quarantine station, and after a post-mortem examination, followed by a bacteriological investigation, the case was found to be one of bubonic plague. Altogether 17 cases of illness occurred at Port Townsend in connection with this ship, and three of the patients died. It was ascertained that the vessel had carried three plague cases among its passengers from Kobe to Yokohama. Among the crew and steerage passengers after the ship reached Port Townsend a number of cases of mild illness, attended with glandular swellings, were discovered on medical inspection by the authorities.

San Francisco.—During March, 1900, the dead body of a Chinaman was removed from a hotel under suspicion that the death had been due to plague, and this opinion was confirmed by bacteriological examination and experiments on animals. Among the commercial community a doubt was expressed as to the correctness of the diagnosis, and, notwithstanding that from March to June, 11 deaths occurred in the Chinese quarter certified as due to plague, 10 being confirmed bacteriologically, the fact of plague being in San Francisco continued to be denied. A number of cases of an ill-defined nature were treated by white physicians as typhoid fever during April and May, some of which were, on removal to hospital, diagnosed as plague.

Montana.—Some suspicion was excited at Butte by the occurrence of an epidemic of pneumonia, 50 per cent. of the cases proving fatal, during the spring months of 1900. No definite details of this outbreak have been obtained, but an epidemic of pneumonia occurring at a time when plague had effected a lodgement on the American Continent gives grounds for some suspicion.

MEXICO.

Rumours reached the United States Government in November, 1899, that a fatal epidemic disease, suspected to be plague, had broken out at *Orizaba*, but that the Mexican Government denied the fact. Some physicians had declared the malady to be typhus fever, some called it an epidemic of "malarial origin" and of a "hemorrhagic type"; others regarded it as yellow fever, and yet others again as plague. This outbreak was investigated by a medical member of the Vera Cruz Board of Health. There had been 180 cases and 118 deaths, a case mortality of 65·5 per cent.

One of the surgeons of the United States Marine Hospital Service reported to his Government that early in 1900 *glandular trouble* had been prevalent on the Mexican border.

In February, 1900, the Surgeon-General of the United States Marine Hospital Service received information that plague existed in the Island of *Cozumel*, off the coast of Yucatan, the infection having been brought from Brazil; but this was also denied. Epidemics of "typhus epidemica" were reported about the same time at *Santa Maria*, *Saltatilo* and *Vera Cruz*.

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SOUTH AMERICA.

PARAGUAY.

Asuncion.—In September, 1899, reports reached this country that plague had invaded Asuncion, the capital of Paraguay, and that it had existed there unrecognised for some time under various designations such as "malarial fever" or "typhus." Local alarm was such that experts were obtained from Buenos Ayres, who, after due investigation, pronounced the cases to be true bubonic plague, and the presence of the disease in Asuncion was officially declared in October, 1899. There were here many cases of the ambulant variety of plague, and frequently such patients did not seek medical advice, and went undetected. Up to November—*i.e.*, in a period of three months—it was reported that 250 cases had come under observation, though the true number of actual cases in all probability far exceeded this figure. Asuncion has a population of about 45,000, and it lies some 600 miles from the coast up the River Plate. From Asuncion plague was carried into adjoining districts, and cases were reported from *Patino-cue*, *Villa del Pilar*, *Itangna*, and *Luque*. It is believed that plague was imported into Asuncion by four sailors who arrived there from Oporto; two of these men died, one on the day of arrival and the other three days later; the third man also died shortly after in a village in the interior, and the fourth had a severe illness attended with buboes, from which he recovered in his native village up-country.

ARGENTINE REPUBLIC.

Rosario.—There were persistent reports during the latter half of 1899 that plague was present at Rosario. But the existence of the disease there was not officially declared till January, 1900. It was afterwards stated that the plague had been prevalent in Rosario for at least three months before it was declared, and that the fact of its presence was concealed officially to prevent injury to local trade. The cases appear to have been of a mild type, and hence, perhaps, a disinclination to believe that so grave a disease as plague was in question. There are no official records obtainable as to the number of cases and deaths which occurred at Rosario. It is not yet known how Rosario became infected. Most of the trade which goes to Asuncion passes through Rosario, and it is therefore possible that Rosario received its infection from Asuncion or indeed that both ports were infected from the same source. Rosario is a great grain-shipping port, and it has been suggested that rats from foreign vessels from infected ports landed at Rosario, bringing plague with them. As has been mentioned, plague was conveyed to Capetown from Rosario in January, 1900, by a forage transport.

Buenos Ayres.—Shortly after it was officially announced that Rosario was plague infected, reports began to circulate that Buenos Ayres was also invaded by the disease. Later on it was admitted that cases had occurred in the city about the beginning of December, 1899. As at Rosario, no figures are available to show the actual number of plague cases and deaths which have occurred. The disease continued to show itself during the first three months of 1900. Probably Buenos Ayres received ship-borne infection from the same source or sources as Asuncion and Rosario.

BRAZIL.

Santos.—On October 18th, 1899, Santos was officially declared infected by plague. The earliest recognised cases were fatal, the diagnosis being established by post-mortem and bacteriological examinations as well as by experiments on animals. The type of the disease was, on the whole, mild, and this led some to think, as elsewhere, that the epidemic malady could not be true bubonic plague. Some medical men insisted that the cases were "pernicious lymphangitis." It is now admitted that the disease had been smouldering in Santos for some months before it was definitely recognised. Some medical men spoke of attending similar cases in July, 1899. Deaths had been certified from "adenitis lymphatica" or as "yellow fever, with buboes." The municipal physician observed that during September many persons came to his medical station suffering from buboes, especially children. Later on, when gland juice was taken from similar cases, the diagnosis of true plague was established bacteriologically. No precise statement as to the number of cases or deaths has been obtainable.

Santos lies about 300 miles south of Rio de Janeiro, and has a population estimated at about 40,000, many of whom are of the labouring class. It is believed that infection was brought by ship to Santos. A statement was at first accepted that plague reached Santos on the "Rey de Portugal," which left Oporto on July 31st, 1899, it being alleged that on board this vessel a great mortality occurred among rats. But later enquiry showed that plague cases had occurred before the "Rey de Portugal" arrived at Santos. Probably the infection was brought on board some previous ship, of which no record is now obtainable. Some persons suggested that plague had been carried from India or Madagascar on board rice-ladened ships.

Sao Paulo, which is a city some 50 miles from Santos, yielded plague cases in the later weeks of 1899. Many of the cases were of the pulmonary form, and the disease struck down the wealthy as well as the poor. The infection was carried from Santos to this city. There is no record obtainable of the actual number of plague cases and deaths which occurred here.

Conceicao dos Guarulhos.—Plague was carried from Sao Paulo to this place by a merchant and his two sons. All three patients were taken to Sao Paulo Hospital for treatment. There is no information as to whether further extension of the disease afterwards took place.

Rio de Janeiro.—Early in January, 1900, plague broke out in this city, and a post-mortem examination of one of the first recognised cases, followed by bacteriological investigation and experiments on animals, confirmed the diagnosis. Though only a few cases were recognised in January, stringent precautions were taken, and apparently the threatened epidemic subsided. In April, however, a fresh outburst took place, beginning in an overcrowded house in which some recently-arrived persons from Oporto were living. It is locally suggested that there had been a re-introduction of the plague infection from Oporto. From May to July, 1900, over 300 cases were reported, and of these 131 died; a case mortality of 43·3 per cent.

Cases of a sort suggestive of plague appeared during the earlier months of 1900 in several other localities in Brazil, the deaths being certified under various designations. At Rio Grande do Sul, for example, "virulent influenza" was given as the cause of a number of deaths, which elsewhere had been strongly suspected to have been due to plague.

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APP. A, No 15.

Precautionary Measures taken to prevent the Importation of Bubonic Plague into England and Wales during 1899; by Dr. Bruce Low.

MEMORANDUM on PRECAUTIONARY MEASURES taken in 1899 to prevent the IMPORTATION of BUBONIC PLAGUE into ENGLAND and WALES; and on certain CASES reported as plague, or suspected plague; by DR. BRUCE LOW.

(1). *Precautionary Measures.*

On August 15th the Local Government Board received from the Foreign Office copies of telegrams intimating an outbreak of plague in Oporto. On the following day a plan for conducting a Port Sanitary Survey, drawn up by the Medical Department, was sanctioned by the Board.

In accordance with this scheme, Drs. Thomson, Copeman, and Reece received instructions to at once visit certain designated ports. Later Drs. Buchanan and Darra Mair were added to this survey staff, and as a precautionary measure, Drs. Mivart and Johnstone were instructed to hold themselves in readiness to lend assistance if the circumstances demanded it.

The ports for which a survey was in the first instance arranged were those trading directly with Oporto and other Portuguese ports, information as to which had on receipt of the Foreign Office's information as to the outbreak of plague at Oporto been sought by the Board of the Customs. A list of such ports was at once forwarded by the Customs, and it was found that 16 ports in this country had communication with Oporto, and five more with other Portuguese ports. In view, however, of the possible extension of the disease to Spain it was deemed advisable to visit all the other English ports and riparian districts having communication by shipping with the Iberian peninsula; these were ascertained to be 18 in number. In this way it was found necessary to inspect during the autumn months of 1899 the following 39 port and riparian sanitary districts:—London, Portsmouth, Southampton, Exeter, Plymouth, Fowey, Falmouth, Padstow, Barnstaple, Bridgwater, Bristol, Gloucester, Newport (Mon.), Cardiff, Barry and Cadoxton, Swansea, Llanelly Urban (Riparian District), Llanelly Rural (Riparian District), Liverpool, Manchester, Lancaster, Holyhead Urban (Riparian District), Fleetwood, Barrow-in-Furness, Millom Urban (Riparian District), Workington, Whitehaven Urban (Riparian District), Maryport Urban (Riparian District), Holme Cultram Urban (Riparian District), Berwick-on-Tweed Urban (Riparian District), Blyth, River Tyne, Sunderland, Hartlepool, River Tees, Hull and Goole, King's Lynn, Yarmouth, and Lowestoft.

To all of these ports and riparian districts advice, general and particular, was given by the Inspectors. Special attention was directed to the need for systematic inspection of shipping, and for the medical examination of all vessels arriving from ports infected, or suspected to be infected, by plague; for the provision of isolation accommodation, and of proper means for disinfection. The means for the disposal of the bodies of persons dying from plague was discussed. The question of destruction of rats, and the means for preventing landing of these rodents from ships was also considered in conference with the local authorities. In certain cases the Board, on the reports of the Inspectors, wrote to direct attention to such shortcomings as might be thought of as dangerous in respect of the introduction of plague. As a consequence, in a number of instances prompt action was taken by the authorities in question to remedy the defects pointed out.

The full details of this port survey are reserved for publication at a later date in a special plague volume.

At the commencement of the survey a circular letter was despatched (copy appended) intimating that what was regarded as bubonic plague had broken out at Oporto, and warning Port Sanitary Authorities to instruct their Medical Officers of Health to give special attention to vessels arriving from Oporto.

Each Medical Inspector taking part in the port survey was supplied with draft forms of letters to Port Sanitary Authorities' clerks, making appointment for conference with the Port Sanitary Authorities' officials, and also with a draft letter to the Chief Customs Officer of the port asking his attendance at the conference.

During the course of the survey some difficulties arose in particular instances with respect to the co-operation of the Customs Officers with the Port Authorities, and representations were accordingly made to the Board of Customs upon the subject. The result was that a circular letter was issued by the Customs to their officers, dated August 25th, 1899 (copy appended), directing them to give every assistance to the Port Sanitary Authorities and to Local Government Board Medical Inspectors in regard to measures for dealing with plague at our ports.

Question also arose in certain instances with reference to the interpretation of the Board's Order of November 9th, 1896, as to what was an "infected" port, or what constituted a "suspected" vessel; as also with respect to sick persons as being British Consular passengers put on board homeward bound vessels, without a medical certificate. And, as to this latter point, an interview was sought with the Board of Trade and a letter was subsequently received by the Local Government Board to the effect that in future a certificate would be obtained in all such cases.

At a conference held on October 13th, 1899, between the Board's officers and representatives of the Customs, a definite understanding was arrived at with regard, not only to the above, but other difficulties. Among important points dealt with was the definition of a "voyage." A ship, for example, arriving at an English port from a foreign infected country, might after discharging the whole or part of her cargo, pass on to another English port. It was ultimately decided to regard such vessel at the second or third port of destination as still coming from foreign. Thus it was agreed that the Customs would in future inform the Port Medical Officer of Health of the arrival of any ship from an

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infected country, notwithstanding that the vessel had already called at an English port, and that the Port Medical Officer of Health should keep the Customs informed as to what countries he regarded as infected by plague.

As a result of these negotiations a General Order was issued by the Board of Customs giving instructions to their officers to co-operate with the officials of the Port Sanitary Authorities, with a view to prevent the introduction of plague into British ports from abroad. A copy of this Order is appended.

With reference to protection against plague of those who might be specially exposed to infection at our ports, the question arose as to provision by the Board of Haffkine's prophylactic for use at English ports, and consultations were held with officials of the India Office as to obtaining a supply of the protective fluid from India, a memorandum on the subject being submitted by the Medical Department to the Board. Whilst these negotiations were in progress, certain applications arrived from the Medical Officers of Health of port sanitary districts asking for a supply of the prophylactic in view of contingencies. Ultimately, a supply of the protective fluid was purchased from India and was stored ready for use.

At the time that these arrangements were in progress, the Board learned that M. Haffkine was in this country on leave from his duties in India. Accordingly the Board secured M. Haffkine's services for a short period to confer with and advise their own officers in all matters pertaining to the preparation, testing, and use of the prophylactic. Consultations were held from time to time during September and October, 1899, at the Office between the Board's Medical Officers and M. Haffkine as to details of his methods of inoculation. The information thus obtained is likely to prove of great service in the event of plague appearing in this country.

As a result of conference with the Board of Trade, a leaflet containing a short description of the symptoms of plague was prepared for the use of sea captains whose ships carry no surgeon. A copy of this leaflet (appended hereto) is now added to the official log book.

Representations were also made to the Board of Trade as to the desirability and practicability of bringing more prominently under the notice of pilots and masters of vessels the provisions of the Board's Order of November 9th, 1896, as to plague, cholera, and yellow fever, and a suggestion was made that a copy of this Order should be embodied in the official log books issued to all masters of ships.

Information was sought through the Foreign Office from British Consuls and Vice-Consuls as to procedure at European ports in supervision of sea-going ships, and as to the regulations and practices in force for the prevention of the exportation of plague by vessels sailing from infected ports.

At each port visited by the Medical Inspectors a copy of directions for obtaining and sending to the Board material from

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suspected plague cases for bacterioscopic examination was left with the Medical Officer of Health for his guidance.

The Board made arrangements with Dr. Klein, F.R.S., of St. Bartholomew's Medical School, to examine any such material forwarded, along with the necessary particulars, to the Board by any Medical Officer of Health.

Under instructions from the Board Dr. Reece visited 7 Riverside Sanitary districts on the Thames and conferred with the officials as regards the supervision of Seamen's Boarding Houses and the Lodging Houses where sailors of one or another class stay when on shore. These districts visited were Poplar, Limehouse, Whitechapel, St. George's-in-the East, Rotherhithe, Greenwich, and West Ham. Dr. Reece also conferred with the Medical Authorities of St Bartholomew's, the London, and Guy's Hospitals with the view of asking that special care should be taken to detect mild or anomalous cases of plague which might come from waterside localities to the out-patient department for medical advice. The same Medical Inspector also conferred with Mr. Shirley Murphy, Medical Officer of Health to the London County Council, regarding the Common Lodging Houses frequented by seafaring folk in the East and South-East of London.

Arrangements were made through Dr. Downes with the Metropolitan Asylums Board whereby a few beds in a detached block at one of their hospitals was kept ready for any emergency.

A communication was sent to the Foreign Office in reference to the desirability of the Board being informed through the agency of the British representative on the Egyptian Sanitary Board as to decision arrived at in the cases of alleged or suspected plague detained at Moses Wells, the Egyptian Sanitary Station at the head of the Red Sea. The Board and certain Port Sanitary Authorities experienced some unnecessary inconvenience owing to there being no arrangements in force for the transmission of such information. Thus in the case of the *Caledonia*, where the alleged cases diagnosed and treated as plague at Suez were subsequently proved not to be plague at all; this fact, though established by the Egyptian Sanitary Board, only came indirectly to the knowledge of the Board some months afterwards.

Action was, in view of the obligation resting on this country as a signatory Power of the Venice Convention, taken to put the Board in a position to learn officially of the occurrence of any case of plague in England and Wales, and in this connection the matter of adding plague to the list of notifiable diseases was considered, and a draft Order was prepared.

(2). *Suspected Plague Inland.*

Subsequent to intimation of the occurrence of plague at Oporto, two alleged cases of plague were reported during 1899 to the Board's Medical Department from different parts of England; but in each instance detailed inquiry, along with bacteriological

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examination, failed to support such a diagnosis. These cases were briefly as follows :—

(1.) A case was reported on August 30th, by the Medical Officer of a large workhouse in the West of England, where a tramp in the casual ward was found to be suffering from fever with numerous enlarged glands. The Medical Officer of Health was consulted and examined the person's blood. He ultimately declared the case to be one of enteric fever. The patient, a cork cutter, was said to have been working with cork-bark from Portugal. In view of the investigation made by the Medical Officer of Health, in whom the Board had complete confidence, it was not deemed necessary to send a Medical Inspector to inquire into the case.

(2.) The second suspected case was reported from the Eastern Counties to the Board on August 31st, and the circumstances were investigated by Dr. Bulstrode on September 1st. The patient, it appeared, had died on August 22nd, and suspicion as to the nature of the illness had arisen partly from the anomalous symptoms observed in the case and partly from the fact that the house, of which he was an inmate, contained certain dressed Hindoo images, which had come from Poona four months previously. The diagnosis was said at first to have been confirmed bacteriologically, but this was erroneous; the evidence, bacteriological and other, was entirely negative as to plague. All proper precautions were, however, taken and no further illness of any kind occurred among persons who had had relations with the patient.

(3.)—*Ship-borne Plague and suspected Plague in English Ports.*

It was to be expected that England with its vast amount of foreign trade and its numerous communications by shipping with ports abroad would be very liable to have plague brought to its shores by vessels arriving from infected ports. The following is a brief summary of reported ship-borne importations of disease suspected to be plague into England during 1899 and the earlier part of 1900 :—

(1.) The s.s. *Dictator*, with a crew of 64, arrived with a cargo of grain at Liverpool on August 4th, 1899, having left Karrachi, a plague-infected port, on June 25th. The following history was obtained of illness on board this vessel during her voyage :—On July 2nd a native fireman was attacked by fever and bubo, and on July 7th a second lascar was also taken ill with similar symptoms. At Suez the Port Medical Officer of Health declared these two cases to be plague, and removed them to the hospital at Moses Wells, along with members of the crew who had been waiting upon them. All the native crew were taken ashore and isolated in the quarantine station, while the ship underwent disinfection. The *Dictator* sailed from Suez on July 19th, leaving behind 23 of the crew, three of whom had developed suspicious illness, which was

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afterwards regarded as not having been plague. On arrival at Liverpool on August 4th, a careful examination of each member of the crew was made; the temperature was ascertained, and the axilla and groin were examined in each instance. Rats caught on board at Liverpool were submitted to Dr. Klein for examination, but the results were negative. Some alarm as to this ship had been created by the news telegraphed from Suez to this country as to plague having occurred on the vessel; and in consequence the Board dispatched Dr. Bulstrode to Liverpool, at the time of the expected arrival of the vessel, to confer with Dr. Hope, the Port Medical Officer, in respect of measures to be taken as regarded the crew and cargo. Fortunately the precautions adopted by Dr. Hope proved adequate, and no further cases came to the knowledge of the Board.

(2.) The British steamer *Minho* arrived at Liverpool on September 4th, 1899, from Oporto, which port she had left on August 31st, and had touched at no intervening place. She had on board six passengers, four of whom were Portuguese, *en route* for South America; the fifth was a woman travelling to Blackburn; and the sixth a consular passenger, a marine engineer, who was recovering from an illness described as "fever," for which he had been treated in hospital at Oporto from August 1st to 31st. He was found on arrival at Liverpool to be suffering from an enlarged inguinal gland, and he was anæmic and weak. Bacterioscopic examination of this man's blood, and of juice from the swollen gland, gave negative results. In answer to inquiries made at Oporto it was stated that he had been detained in hospital there suffering from "typhoid fever and gleet," but there were no signs of the latter condition when he was examined at Liverpool, though the patient afterwards admitted that he had had an attack of gonorrhœa some three months prior to his admission to the hospital. It appears that this man had been on a previous voyage with another ship at Oporto for five days, from about July 8th to 11th, during which period he had been on shore on one night only. He returned on the ship to Ardrossan, and sailed to Newport (Mon.), and thence back to Oporto, which he reached upon this second occasion on or about July 29th. Feeling then too ill to work, he was taken to hospital on August 1st, and remained there till he was put on board the *Minho* on August 31st. Plague is now known to have been present in Oporto during July; wherefore it is possible this man contracted that disease during his stay in the port, *i.e.*, between July 8th and 11th, and that his attack being of a mild form did not prevent him for a time from performing his duty, but that becoming worse later on, he had to be taken to hospital on his return to Oporto. The bacteriological examination made by Dr. Balfour Stewart at Liverpool was negative, as might have been expected, since all acute symptoms had long ago subsided; but this does not exclude the possibility of the man having had plague in July. Further, it is known that not uncommonly cases of plague have been at first diagnosed as "typhoid fever," and that at Oporto a number of medical men admit having met with cases of illness, prior to July 1899, characterised by fever and glandular swellings, which cases, some of them fatal, they had certified as "typhoid fever," but which they now regard as having been plague. But if this man on the *Minho* had plague in July, he was not likely to be in an infective state when he arrived at Liverpool on September 4th. Nevertheless the vessel, as well as the patient's clothing, &c., were carefully disinfected; the addresses of the passengers were taken, and other precautions were carried out. In this instance one of the Board's Inspectors, Dr. Reece, conferred with the Liverpool Port Medical Officer of Health, Dr. Hope, as to the details of the case and as to the measures taken to prevent any danger arising therefrom.

In addition to these examples of suspected plague, three other instances occurred on board ships arriving at Liverpool during 1899, in which the port officers having detected what they regarded as suspicious illness, took certain precautionary measures to prevent extension of infection until proof had been received through bacterioscopic examination that the illness in question was not plague. These instances occurred on (*a*) the s.s. *Hardwick Hall*, which arrived from Rangoon on September 16th; (*b*) the s.s. *Persia*, from Bombay on September 16th; and (*c*) the *Iron Prince*, from Alexandria on September 28th. In each instance bacteriological investigation showed that there was no sufficient basis for the suspicion of plague; but these occurrences serve to show that the port authorities at Liverpool were alive to their responsibilities, and that due precautions were habitually taken to prevent the importation of plague into this country *viâ* that port.

(3.) On October 14th the P. and O. steamer *Peninsular* arrived at Plymouth flying the yellow flag. She had on board a coal trimmer, a Sidi boy, suffering from suspected plague. The vessel had left Bombay on September 23rd, touching at Aden on September 28th, Port Said on October 3rd, Marseilles on October 9th, and Gibraltar on October 11th. The patient had reported himself to the ship's surgeon on October 9th, *i.e.*, more than a fortnight after leaving Bombay, as suffering from fever and a painful swelling in his groin. He was at once isolated and thereafter progressed favourably. On arrival at Plymouth he had no fever, but he was transferred at once, along with the man who had waited upon him, to the port floating hospital. All the usual precautions were taken, including disinfection of the deck cabin in which the man had been isolated. The case was diagnosed as one of mild plague, but no satisfactory explanation of the origin of the infection could be obtained. The crew had all been shipped at Bombay and had been medically examined before they embarked. There had also been a daily inspection of the crew by the ship's surgeon during the voyage. No dead rats were discovered on board. The ship after disinfection at Plymouth proceeded to the Thames, arriving there on October 15th. The crew were kept under medical supervision while in dock, but no case of suspicious illness of any kind occurred among them, or in any one connected with the ship. The patient was kept in hospital for five weeks and then returned to India in good health. Bacteriological confirmation of the diagnosis of plague was not found possible in this case as the bubo was suppurating when the man arrived at Plymouth, but in every other respect the diagnosis was said to have been fully established.

(4.) On December 16th the P. & O. steamer *Ballarat* arrived at Plymouth from Calcutta, having on board a case of illness suspected to be plague. The patient, a Mahomedan coal trimmer, first became ill on December 13th. The vessel had left Calcutta on November 14th, so that the disease appears not to have manifested itself till 29 days after leaving port. The *Ballarat* called at Colombo on November 20th, Aden November 29th, Suez December 2nd, Port Said December 4th, Malta December 8th, and Gibraltar December 11th. The sick man on arrival at Plymouth had enlarged and tender femoral glands in both groins and a small swelling in one axilla. He was at once removed to the floating hospital. The ship's surgeon reported to Dr. Williams, the Port Medical Officer, that the case had been isolated along with all his effects in a deck cabin, and that all necessary precautions had been taken. At Plymouth the crew and passengers were medically inspected and all were found well; the names and addresses of those landing were taken and forwarded to the Sanitary Authorities at their respective destinations. The contents of the patient's cabin were in part destroyed by fire and the rest passed through a steam disinfector. The cabin itself was disinfected. After completion of these measures the ship sailed for London, the Medical Officer of that port being duly informed of the above circumstances by telegraph. No other suspected cases had occurred during the voyage from Calcutta, nor did any illness of a suspicious nature develop among the crew or passengers after their arrival in this country. The bacteriological examination was in this instance also negative, and it was suggested medically that the case was one of "multiple adenitis." The case, however, was dealt with as if it had been one of undoubted plague.

(5.) On January 23rd, 1900, a foreign steamer, the *Joseph Brailli*, arrived at Swansea from the Mediterranean with a sick Austrian sailor on board suffering from fever, great depression, and inflamed and swollen inguinal glands. The man's appearance excited suspicion of plague, and Dr. Davies, the Port Medical Officer of Health, sent him to be isolated at the port hospital, and forwarded specimens of blood to the Board for bacterioscopic examination. The results of this examination were wholly negative. A few days' rest in hospital sufficed to improve the man's condition, and on January 31st he was so far recovered as to be able to rejoin his ship. The glandular affection was afterwards definitely proved to have been due to venereal disease.

On several occasions during 1899 suspicion arose that vessels arriving at Falmouth with cases of sickness on board, might be plague infected. In one instance, for example, during September on the barque *Taurus*, four of the crew within a fortnight had died at sea during the voyage from Florida. Four other persons on board were found ill on arrival, but the Port Medical Officer of Health pronounced the illness to be beri-beri. In another instance the sailing ship *Rigal* from Rangoon, which arrived at Falmouth on September 24th, reported nine of

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As to such ships so arriving, the earliest possible notice is, until further orders, always to be given to the Local Health Authorities with a view to the adoption of whatever special precautions may be deemed necessary by them. Ships are, however, not to be detained in such circumstances.

By Order of the Board,
(Signed) R. T. PROWSE.

ADDENDUM II.

Secy- Customs.
No. $\frac{13238.}{1899.}$

General Order $\frac{74}{1899.}$

CUSTOM HOUSE, LONDON,
31*st October*, 1899.

FURTHER PRECAUTIONS AGAINST THE INTRODUCTION OF PLAGUE.

17th August, $\frac{10338}{1899}$.
25th August, $\frac{10748}{1899}$.
4th October. $\frac{12287}{1899}$.

(1.) By recent Circulars, as noted in the margin, and of which printed copies are appended, the Board have drawn the attention of the Department to the necessity for the exercise, at the present time, on the part of Boarding Officers, of the utmost vigilance with a view to preventing the introduction of Plague by means of Vessels reaching British Ports from abroad.

(2.) These instructions the Board now desire to emphasize, by directing Collectors and other Officers in charge of Ports to impress upon responsible Boarding Officers the importance of always working in complete harmony and co-operation with the Medical Officers of Health of the Port Sanitary Authorities at the respective Ports.

(3.) In this connection, particular attention is to be given to Article 8 of the Local Government Board Order dated the 9th November, 1896, issued with General Order $\frac{68}{1896}$, which empowers local Medical Officers of Health who have reason to suspect that any ship either

(*a*) is infected, or

(*b*) has come from an infected place,

to visit and examine such ship *whether she has already been "examined by the Officers of Customs or not."*

(4.) The more immediate object of this Order is to make it clear to Boarding Officers that, in any case where a Medical Officer of Health informs them that he desires to visit all ships arriving from a particular Port or Country designated by him, it is expected of the Boarding Officers that, without interfering with their duties under General Order $\frac{68}{1896}$ or any subsequent similar directions, they will give to the Medical Officer of Health any information which they may possess, or which may come to them in the course of their duties, respecting the arrival or impending arrival of any ship from such Port or Country, "with a view to the "adoption of whatever special precautions may be deemed to be necessary" by the Medical Officer of Health (*see* Circular $\frac{12287}{1899}$), for the purpose of giving effect to Article 8 of the Local Government Board Order above quoted.

(5.) It is also expected that, as far as they can do so without undue interference with their own regular Boarding duties, the Boarding Officers will assist the Medical Officer of Health in getting on board any ship which he may be desirous of visiting under that Article, before anyone on board has had opportunity of getting on shore.

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(6.) In cases where the Boarding has necessarily to be done by boat (steam or row) it is expected of the Boarding Officers that, in the case of a ship coming from a particular Port or Country designated by the Medical Officer of Health, they will, when they are starting for the vessel, facilitate, as far as they consistently can, the visit of the Medical Officer of Health, and will impose no difficulties that can be avoided in conveying him with them on board the incoming ship.

(7.) The Board expect of Collectors and other Officers in charge of Ports that, in order to further the carrying out of the directions of paragraph (4) of this Order, they will also make it their business to ascertain beforehand, as far as may be practicable, and to communicate to local Medical Officers of Health, information as to the impending arrival of any ships from Ports or Countries which may have been designated by the Medical Officers as open to suspicion.

(8.) Also, until further notice, the directions of the Circular, 4th October, $\frac{12897}{1899}$, regarding the treatment of ships arriving from Countries or Ports which have thus been designated by the Port Medical Officer of Health as open to suspicion, *viâ* another Port or Ports of call in the United Kingdom, are to be read as requiring that, in every such case, the same procedure shall be applied, in all respects, as if she had first arrived at the second or any subsequent British Port of call directly from foreign.

(9.) This Order is more particularly directed to Officers at Ports in England and Wales, but it is to be read as of equal application, as occasion may require, at Ports in Scotland and Ireland, with reference to the Orders, corresponding to that of the 9th November, 1896 (England and Wales), as above quoted, as issued by the respective Local Government Boards in those parts of the United Kingdom.

By Order of the Board,
R. T. PROWSE.

ADDENDUM III.

Circular.

Precautions against introduction of Plague.

Local Government Board, Whitehall,
9th December, 1899.

2 Copies.
Customs Order, 74/1899.

SIR,

I AM directed by the Local Government Board to state that they have lately had under consideration the precautions to be taken for preventing the introduction of the infection of plague into this country, having regard to the existence of the disease in Portugal, the voyage from which country to this is of less duration than the term to which the period of incubation of the disease not uncommonly extends.

It is of great importance that the supervision of shipping by sanitary officers, and in particular the examination, under Article 8 of the Board's General Order of the 9th of November, 1896, of ships arriving from places known to be infected with plague, should be carried out with especial care; and the Board have been in communication with the Commissioners of Customs, with a view to securing that the greatest possible assistance shall be rendered by Officers of Customs to Medical Officers of Health in carrying out the regulations in that Order.

The Commissioners of Customs have cordially co-operated with the Board in this matter, and have issued to their Boarding Officers a General Order, of which two copies are enclosed. It is requested that one of these copies may be handed to the Medical Officer of Health, and that his particular attention may be drawn to its object and provisions.

It will be seen from paragraph 4 of the Order, that the Officers of Customs will look to the Medical Officer of Health to inform them from time to time of any particular ports or countries, the vessels arriving from which the Medical Officer of Health may desire to visit; and, in this connection, the Board would observe that the earliest information which would usually be available to this end is that which would be obtained by a regular examination of the news telegraphed from abroad for the purposes of the daily Press. The Officers of Customs, having thus been communicated with, will then, on their part, give the

Medical Officer of Health any information they may possess respecting the arrival, or impending arrival, of any ships from the ports or countries indicated. The Board are desirous that the Medical Officer of Health should avail himself to the full of this valuable assistance; and that, in view of the facilities offered him under paragraphs 5 and 6 of the Customs Order, he should, on his part, use every effort so to carry out his duties as to cause the least possible inconvenience or delay to the Customs Officers in the discharge of their duties, and thus to obviate, as far as may be practicable, any ground of complaint on the part of the shipping interest.

I am to request that the Sanitary Authority will at the same time consider whether their existing sanitary staff is adequate for the prompt performance of the duties thus devolving on the Medical Officer of Health, in connection with the supervision of shipping generally in the district. It will be remembered that under Article 1 of the Board's Order of the 9th of November, 1896, the term "Medical Officer of Health" in that Order includes any duly qualified medical practitioner appointed or employed by the Sanitary Authority to act in the execution of the Order.

I am, Sir,
Your obedient Servant,
S. B. Provis,
Secretary.

The Clerk to the
Port Sanitary Authority.

ADDENDUM IV.

A description of the symptoms of plague inserted in the official log book for the use of Ships' Captains when out of reach of Medical Assistance.

HOW TO KNOW PLAGUE.

An attack of plague may begin some three to eight days after exposure to infection, either suddenly or gradually, but as commonly met with there is a sudden onset with much fever, as indicated by a high temperature, rapid pulse, headache, hot skin, and thirst. The eyes are frequently injected as if inflamed. the expression at first anxious and frightened becomes subsequently vacant and dull, the utterance is thick and the gait unsteady as in one under the influence of drink, and there is at times a distinct tendency to faint. The tongue is at first covered with a moist white fur except at the edges which are red, but later on it becomes dry and of a mahogany colour.

The most distinctive sign of plague is, however, the presence of swellings, or "buboes" as they are called, in the groin, armpit, neck or elsewhere. These "buboes," which led to the disease being called "bubonic plague," and which have no relation to venereal complaints, appear as a rule about the second or third day of the disease. They are usually painful and tender on pressure. and in size they vary from that of an almond to that of an orange. Later on they may "gather" and burst like an ordinary abscess. There may, too, appear about the body purple spots, and what are known as "carbuncles."

It is of great importance to bear in mind that at times when plague is prevalent mild cases may occur which present no other signs or symptoms than a painful swelling in the groin or armpit; and a man who has been exposed to plague, and who exhibits these symptoms, should be isolated and watched until medical advice can be secured, as such cases may be instrumental in spreading the disease. It is also necessary to remember that what is known as the "pneumonic" variety of plague, which is highly infectious, the most prominent symptoms are those of inflammation of the lungs, there being high temperature, a short troublesome cough, rapid and difficult breathing, pain in the chest, and later on the coughing up of prune-coloured phlegm.

No. 1.

ON PSEUDO-TUBERCULOSIS, ITS PATHOLOGY AND ETIOLOGY ;

BY DR. E. KLEIN, F.R.S.

The term "Pseudo-tuberculosis" was in 1885 first employed by Eberth* in connection with nodular deposits in the viscera observed by him as occurring now and again "spontaneously" in the rabbit and the guinea-pig. These deposits in the spleen, liver, lymph glands, kidneys, intestine and lungs of the affected rodents exhibit in the early phases inflammatory aggregations of leucocytes, and in the later phases necrotic caseous degeneration with death (coagulation necrosis) of the surrounding tissue, precisely similar to the conditions regarded as peculiar to true tubercle. But the difference between the two processes is fundamental, inasmuch as true tuberculous nodules are caused by the tubercle bacillus, whereas in the deposits of pseudo-tubercle now in question the tubercle bacillus is conspicuously absent.

Malassez and Vignal† had previously (1883–84) inoculated the guinea-pig with matter of a caseous subcutaneous nodule from a child dead from tubercular meningitis. This caseous subcutaneous matter, though it did not contain the tubercle bacilli, produced nevertheless in the inoculated guinea-pigs caseous deposits in the lymph glands and viscera similar to those in artificially inoculated true tubercle ; but with the difference that the process was much accelerated and that the caseous deposits, free of tubercle bacilli, contained round or oval cocci, also in chains and in zoogloea, hence the term "tuberculose zoogleïque."

Eberth himself describes either masses of cocci or else bacilli in the pseudo-tubercular deposits in guinea-pigs and rabbits. A. Pfeiffer,‡ however, was the first to succeed in obtaining in pure culture from the caseous necrotic deposit in pseudo-tuberculosis a definite bacillus which, when inoculated into rodents, produced the typical deposits of pseudo-tuberculosis.

Pfeiffer isolated the bacillus of pseudo-tuberculosis in this manner. Material having been obtained from certain nodules in the lung and lymph glands of a horse that had been killed because suspected of glanders, two guinea-pigs were inoculated therewith. They died on the eighth and ninth day after inoculation, showing great swelling of the inguinal lymph glands, and numerous nodules in the omentum, liver, and spleen. From the nodules of the liver pure cultures of the bacillus pseudo-tuberculosis were obtained, with which positive and typical results were produced in rodents alike by inoculation and ingestion ; the nodules that appeared in the experimental animals in turn containing abundantly the same microbe. A number of other observers (Charrin and Roger 1888, Nocard 1885, Legrain 1891, Luboletti, Kutscher, etc.) have described pseudo-tuberculosis in various animals (guinea-pig, fowl, calf, mouse, &c.); but Preisz (Preisz and Guinard, Preisz and Norey) has in addition carefully studied the bacillus of pseudo-tuberculosis ("Annales de l'Institut Pasteur," 1894, N. 4), and has fully confirmed A. Pfeiffer as to the morphology, biology, and physiology of this microbe.

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* Virchow's Archiv Vol. 100 and 103 and Fortschritte d. Medizin Vol. 3, N. 22, 1885).

† Tuberculose zoogleïque, Archiv de Physiologie normale et pathologique 1883-1884.

‡ Uiber die bacilläre Pseudotuberculose der Nagethiere, Leipzig 1889.

A number of authors, on the other hand, have applied the name pseudo tuberculosis to nodular necrotic deposits in the various organs due to various causes—blastomycetes, streptothrix, aspergillus, protozoa, etc. But it is quite obvious that the term pseudo-tuberculosis, if it is to have a place in pathology as indicating an infective and communicable morbid process of a definite character and produced by one definite species of microbe, should be limited to the morbid process described by A. Pfeiffer as caused by the bacillus of pseudo-tuberculosis. In these pages I adopt this course; "pseudo-tuberculosis" meaning for me that definite, subacute to chronic, disease which is associated with and is caused by the bacillus of pseudo-tuberculosis of Pfeiffer.

A.—DISTRIBUTION IN NATURE OF THE BACILLUS OF PSEUDO-TUBERCULOSIS.

Water in its relation with the bacillus.

During analyses of samples of water which I carried out for the London County Council during the first quarter of 1899, I had, on a particular occasion, inoculated guinea-pigs subcutaneously in the groin with the sediment (filter-brushings) of water taken from the River Lea (mid-stream at Ponder's End) near the intake of the East London Water Company. The amount of sediment injected in each instance corresponded to about 100 cc. of the water. The experimented animal developed in the course of the first week a gradually enlarging inguinal tumour, at first soft, but which soon became firm. At the end of a month the tumour was of about the size of a filbert and on the whole quite firm. The animal thus suspected to be affected with tubercle, was killed after additional 25 days and presented the following post-mortem appearances:—The inguinal tumour, which comprised the enlarged inguinal lymph glands, when cut into consisted of a necrotic whitish partly purulent mass. In the abdominal cavity the following changes were noticed: the liver was enlarged and permeated throughout by angular or round, punctiform, whitish spots, which on the surface were in parts so closely placed that they formed more or less confluent patches of considerable size; the spleen, enlarged to two to three times the normal size, was permeated by numerous small and large white nodules; the omentum, as also the pancreas, contained quite a chain of whitish, small and large, nodules, which when cut into were either of a firm necrotic caseous nature or contained thick purulent matter; the pelvic lymph glands were enlarged, firm, caseous, necrotic or nodules; in some of these (near the free surface) the necrotic partially purulent; as were the portal and mesenteric lymph glands; the lungs showed several greyish white large nodules and also groups of punctiform white nodules; the bronchial glands were enlarged and partly necrotic, partly purulent.

The appearances presented by the inguinal lymph glands, and by the lymph glands and viscera of the abdomen and chest, bore so much resemblance to true tubercle such as is produced by inguinal inoculation of the guinea-pig with some tuberculous matter that I concluded that this guinea-pig was actually affected with this disease. Cover glass specimens, however, which were made of the caseous and purulent matter of the various lymph glands and viscera, failed one and all to reveal tubercle bacilli. It became therefore clear that the disease, although strongly resembling tubercle in its distribution and general pathological anatomy, could not have been that malady. Further cover glass specimens were then made with a view of discovering other bacteria, and by suitable staining of these (*see* below) it was soon ascertained that in the necrotic and in the purulent matters of all the affected organs there were present abundant short thick oval bacilli, characteristically grouped together in the necrotic parts, and found both singly and in groups elsewhere, particularly within the protoplasm of leucocytes in the necrotic and purulent portions of the deposits. Cultures on gelatine and agar in plates and in tubes were made from "tubercles" of several of the diseased lymph glands of the liver, the spleen, and the lung. In all cultures one kind of colony was obtained in great numbers and in a pure state. Further sub-culture and further inoculation experiments proved that this one kind of colony was the bacillus of pseudo-tuberculosis of A. Pfeiffer. With the caseous matter of the lymph glands (inguinal, pelvic, portal), and with matter of the "tubercles" of the liver, spleen, and lung, a series of guinea-pigs were inoculated subcutaneously in their groins, a few drops of a milky emulsion (made from those materials in sterile salt solution) being injected into each animal. All these guinea-pigs developed the same necrotic enlargement of the inguinal lymph glands, the same white deposits in the liver and spleen (in some also in the omentum); the pelvic glands were also enlarged, firm, and caseous. But in all the animals the morbid process seemed much accelerated as compared with that of tuberculosis similarly induced. They all died in from 13 to 18 days. No trace whatever of tubercle bacilli could be found in their morbid deposits; the bacilli of pseudo-tuberculosis could alone be demonstrated, as was done abundantly in film specimens as also by culture.

There can then, be no doubt that this sediment deposited by water of the River Lea contained the bacillus of pseudo-tuberculosis. I therefore repeated the experiment, both with water of the River Lea and with water of the River Thames. Of the former a sample was collected mid-stream at Ponder's End, of the latter a sample from mid-stream above Hampton, just above the intake of the water companies. As before (500 cc. of the water were filtered through a Pasteur filter, the outer surface of the candle was then brushed off and distributed in 5 cc. of sterile distilled water), so much of the emulsion of "filter brushing" was injected (1 cc.),

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as would correspond to the sediment of 100 cc. of the original water.

The following are these additional experiments and their results:—

With sediment of Lea Water, injected (February 22nd), one guinea-pig subcutaneously; result positive.

„ „ „ „ (March 15th), one guinea-pig intraperitoneally; result positive.

„ „ „ „ (June 10th), two guinea-pigs subcutaneously; results negative.

„ „ „ „ (June 17th), two guinea-pigs subcutaneously; results one positive, one negative.

Of the sediment of Thames Water, injected (February 22nd), one guinea-pig subcutaneously, one guinea-pig intraperitoneally; results negative.

„ „ „ „ (June 19th), two guinea-pigs subcutaneously; results both positive.

„ „ „ „ (June 25th), two guinea-pigs subcutaneously; results both negative.

In every case as regards pseudo-tuberculosis positive cultures were made of the deposits and further guinea-pigs inoculated, in all cases again with positive results.

Sewage in its relation with the bacillus of pseudo-tuberculosis.

Having in this way ascertained that both the raw Lea water and the raw Thames water are apt to contain the bacillus of pseudo-tuberculosis, it became necessary, since both these rivers notoriously receive sewage through various sources, to inquire whether sewage contains this bacillus and contributes it to the above rivers. Accordingly I made a number of experiments

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with the sediment of *raw* sewage, injecting guinea-pigs subcutaneously, some with small, and others with large doses. The result was this. Two guinea pigs injected with a large dose (about ½ cc.) of the sediment of crude domestic sewage, died both of them from septicæmia. Of other two guinea-pigs injected with a small dose (two or three drops) one developed an acute disease due to a new microbe (bacillus pyogenes cloacinus) which I shall describe later in this report in reference to its morphology, culture, and action on the rodent animal; the other guinea pig had at first a small tumour, but this disappeared before the end of the week and the animal escaped further disease. Of two further guinea-pigs inoculated with two to three drops of the sediment of crude sewage, one developed the appearance of pseudo-tuberculosis of the lymph glands, liver, and spleen, and as was then proved by cover glass specimens and by the culture tests did in fact suffer from pseudo-tuberculosis, the second of these guinea-pigs developed a small temporary tumour, but this soon disappeared and the animal recovered.

Next, two guinea-pigs were inoculated subcutaneously with a largish dose (about ¼ to ½ cc.) of sediment from sewage *effluents*. Both guinea-pigs developed the typical disease pseudo-tuberculosis of the inguinal lymph glands, of the spleen, of liver, and of the lung. Dr. Houston had previously shown me a guinea-pig which had died after subcutaneous injection with sediment of a particular sewage effluent, and which presented appearances thought to be those of tuberculosis. I examined the viscera of this animal and found that the deposits in them were not true tubercle but the pseudo-tuberculosis now in question.

It is clear then that raw sewage and also certain sewage effluents may contain the bacillus of pseudo-tuberculosis, and that the best way to demonstrate this is by injecting a largish dose of the sediment of sewage or of effluent subcutaneously into guinea-pigs. As will presently be noted, the colonies of the bacillus of pseudo-tuberculosis have, particularly in their earlier phases in gelatine plate cultures, so much resemblance to those of the bacillus coli that I did not attempt to isolate the former directly from the sediment of sewage or effluent; I was indeed the less inclined for such attempt since it is a more easy and reliable way to do so through the body of the guinea-pig.

Milk in its relation with the bacillus of pseudo-tuberculosis.

I have shown in my Report of 1897–98 that milk, such as is sold in the London retail shops, contains in a percentage of cases the spores of the virulent bacillus enteritidis sporogenes—a microbe constantly present in sewage, fæcal matter, and street dust containing horses' manure. It became therefore interesting to inquire whether such milk harbours perchance also the bacillus of pseudo-tuberculosis.

The following samples of milk bought at London retail shops were subjected to experiment. The milk was, in each instance, placed in the ice chest, kept there for 20 to 24 hours, and of

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the sediment of each sample 2 cc. were injected into a guinea-pig:—

Sample 1, July 26—1 guinea-pig; result, positive.
„ 2, July 26—1 „ „ negative.
„ 3, Aug. 1—2 guinea-pigs; result, negative.
„ 4, Oct. 3—1 guinea-pig; result, positive (?) few nodules in liver.
„ 5, Oct. 3—1 „ ; result positive, liver and spleen permeated by nodules.

From this it follows that the sediment of milk sold in London retail shops may contain the bacillus pseudo-tuberculosis, inasmuch as of five samples two certainly caused the disease pseudo-tuberculosis in guinea-pigs injected therewith.

I have had from time to time the opportunity of examining the sediment of 97 samples of milk delivered at London railway stations direct by the dairy-farmers. Of these 97 samples, subcutaneous injection of milk sediment into guinea-pigs produced the typical disease pseudo-tuberculosis in six separate instances. This is a lower percentage than in the case of the London shop milk samples, but it shows that even milk such as comes direct from the dairy-farm may also harbour the bacillus of pseudo-tuberculosis.

I refer below to direct experiments which show how easily the disease is communicated by ingestion to the Peyers glands of the intestines, to the mesenteric lymph glands, and, further, to the spleen and liver of guinea-pigs. It will also be shown that the disease may be readily communicated to the ape. Other observers have claimed that nodular deposits occur in the human subject which are those of pseudo-tuberculosis, for the sufficient reason that material of these deposits on inoculation into the guinea-pig has been found to produce in this animal the disease in question. In view of these considerations, I think it is not too much to say that the presence of the bacillus of pseudo-tuberculosis in milk may probably play a part in causing pseudo-tuberculous disease in the human subject.

B.—THE PATHOLOGY OF THE DISEASE PSEUDO-TUBERCULOSIS.

In all instances in which the disease has been, by different observers, experimentally induced by inoculation with material directly from an animal source, it showed itself in eight to ten days as a subacute malady associated with swelling of the lymph glands. These, post-mortem,. presented necrotic patches and nodules, as did also the surrounding connective tissue; in addition there were firm whitish nodules in the omentum, liver, spleen, and even in the kidney and lung. In all the instances in which the disease was produced in my own experiments as the result of injection of sediment of Lea water, of Thames water, of sewage or of milk, the disease developed in the course of four or more weeks. It, however, took considerably less time if the necrotic materials of deposits taken direct from experimental animals were used for injection of further animals; for in the latter animals the disease, besides being more intense and extensive, was at the same time much quicker in its course. In these cases the swelling and necrotic purulent change of the lymph glands near the seat of inoculation was demonstrable within 3–7 days; extensive nodular deposits in the liver and spleen appeared as early as the second week. A fatal issue occurred at any time between 7 and 20 days, on the average about the end of the second or commencement of the third week. If induced by subcutaneous injection of small doses of pure culture of recent date (on gelatine, on agar, on serum, or in beef broth) the disease develops rapidly and ends lethally in from 9–16 or 18 days; and the nodular necrotic-purulent deposits in the spleen, liver, omentum, pancreas, lung, kidney, visceral lymph gland are very numerous.

I will, for the sake of illustration of the pathology of the disease resulting from subcutaneous injection, describe two inoculation experiments.

(1.) Two guinea-pigs, Nos. 1 and 2, were, on 22nd March, inoculated subcutaneously in the groin with a few drops of an emulsion in salt solution of the matter of the enlarged portal lymph gland of the guinea-pig (*a*) that had been inoculated with sediment of Lea river water. Within two days the inguinal lymph glands of the groin of the inoculated side became in each instance enlarged and firm. This enlargement proceeded rapidly, till on the twelfth day the groins contained firm oblong tumours of about the size of filberts.

Animal No. 1 became thin and was found dead in the morning of the thirteenth day. On post-mortem examination the tumour in its groin was found circumscribed subcutaneously. It comprised the lymph glands and as well the surrounding connective tissues. When cut into it was firm, white and necrotic. The pelvic lymph glands were enlarged, firm, and partially necrotic; the liver and spleen were enlarged and pervaded by punctiform to millet-seed sized whitish nodules; the portal and splenic glands were enlarged and firm; in both lungs were whitish, firm nodules, small, round or angular, or grouped in masses, the surrounding tissues being much congested.

Guinea-pig (No. 2) was found dead in the morning of the sixteenth day. Post-mortem, a firm inguinal tumour comprised the lymph glands of the groin, and it contained necrotic-purulent foci. The liver and spleen were much enlarged, and contained in all parts small and large whitish necrotic nodules, as did the portal lymph glands and those of the pelvis. In both lungs were several irregular caseous nodules; the omentum next to the large curvature of the stomach (inclusive of the pancreas) contained several caseous-purulent nodules.

As regards both guinea-pigs, the nodular necrotic deposits were examined by film specimens. But in no instance were tubercle bacilli or any other acid-fast bacilli found; only the bacillus of pseudo-tuberculosis. Numerous cultures were made from all the swollen lymph glands, from the liver, spleen, and lung; and pure cultures of the bacillus pseudo-tuberculosis were obtained.

(2.) The second of these experiments was inoculation into guinea-pigs of pure culture of the bacillus of pseudo-tuberculosis.

0·2 cc. of a broth culture (incubated 48 hours at 37° C.) was injected subcutaneously in the groin of a guinea-pig. In 48 hours the groin contained a distinct tumour, which went on enlarging. The animal was found dead on the sixth day. Post-mortem, the subcutaneous tissue of the groin of the injected side was swollen and œdematous. The lymph glands were firm and swollen. The liver was dark and contained about half a dozen millet-seed sized white nodules. The spleen was enlarged and pervaded by white nodules. The right lung was much congested.

Next, a platinum loopful of a 48-hours old surface-agar culture of the bacillus of pseudo-tuberculosis (isolated from guinea-pig (*a*), of Lea water origin) was, after distribution in sterile salt solution, used for injection subcutaneously of two guinea-pigs, two rabbits, and two mice. I will leave out of account for the present these rabbits and mice; they are only mentioned as indicating that the amount of culture used for the two guinea-pigs together could not have been more than one-third of the original loopful of culture. The two guinea-pigs appear in my note book as Nos. 8 and 9, and as such they will be here referred to.

Three days after the injection both guinea-pigs showed distinct tumour in the groin of the injected side. On the ninth day this tumour was firm and of the size of a pigeon's egg. The animals were by now getting thin and off their feed. On the twelfth day one guinea-pig (No. 8) showed an open suppurating tumour; the animal was quiet and was very thin. It was now killed. Post-mortem—In the groin on the injected side there was a large-sized (about as big as a filbert) tumour, involving the inguinal lymph glands and the connective tissue surrounding them. When cut into it presented a white, necrotic, partly purulent mass. Both the liver and the spleen were enlarged and permeated by small and large, whitish, firm, caseous nodules, some of them partly purulent. The spleen showed a few adhesions with the abdominal wall. The pelvic glands were enlarged, and partly caseous, partly purulent. The lungs contained about a dozen nodules, grey in the periphery, white in the centre, exactly like true typical tubercles. In none, however, of the deposits in the abdominal viscera, and in none of those in the lung, were any true tubercle bacilli demonstrable, only the bacillus of pseudo-tuberculosis. Fig. 1, Plate I, shows the appearances of the fresh liver and spleen of this animal.

The second guinea-pig, No. 9, had on the eighteenth day an open suppurating gland in the groin on the injected side. The animal was greatly emaciated; it was found dead in the morning of the nineteenth day. The post-mortem appearances were like those of the companion guinea-pig, but the disease was more extensive, especially as regards the omentum and pancreas, which contained numerous, partly caseous, partly purulent, nodules. The swollen pelvic lymph glands contained several purulent foci. In the purulent matter of the inguinal tumour, of the pelvic gland, of the nodules of the omentum, and in the purulent matter of some of the nodules of the liver and spleen, the bacillus of pseudo-tuberculosis was present in enormous numbers, chiefly enclosed within the protaplasm of swollen leucocytes (*see* below).

I think the foregoing sufficiently illustrates the pathological appearances in the guinea-pig. I here, however, note that on using old cultures—*e.g.*, three or more weeks old—injected in minute doses, the fatal issue may be retarded to a considerable degree, or it may indeed even be altogether avoided, the animals at first showing distinct symptoms of the disease but recovering later. Nevertheless, the duration, course, and pathological appearances above described may be taken to represent those of the typical disease as produced directly by using the material from an animal dead after a previous injection, or indirectly by using a recent culture of the virulent bacillus of pseudo-tuberculosis.

In the *rabbit*, the disease produced by subcutaneous injection in the groin with virulent material was of the following character:—By the end of the week there was a small firm nodule to be felt in the groin, which towards the end of the second week assumed a considerable size, about the size of a pigeon's egg. The tumour remained firm and comprised the inguinal glands. The animal became thinner. When killed after 15 days, the following appearances were noticed:—The lymph glands of the groin on the injected side were white, enormously enlarged, caseous, and contained numerous purulent foci; the liver was enlarged and studded with white necrotic nodules, some being irregular and large; the spleen was enlarged, and permeated with white necrotic nodules; the pelvic glands were enlarged, caseous, and white. From this it follows that the process is of the same character as was described of the guinea-pig.

In the *mouse* subcutaneous inoculation with virulent culture causes acute disease and death from general septicæmic infection. Two mice were inoculated under the skin of the back with a minute dose of recent agar culture. They both were found dead on the fourth day, and on post-mortem the viscera were much congested, though at the seat of injection there was no particular change. Cultures made from the heart's blood and from the blood of the liver and spleen yielded crowds of colonies of the bacillus of pseudo-tuberculosis.

Pseudo-tuberculosis can be readily produced also in the *monkey* by subcutaneous inoculation.

A loopful of culture having been taken from the surface of a recent gelatine culture (incubated four days at 20° C.) and distributed in 2 cc. of sterile salt solution, $\frac{1}{4}$ cc. of the mixture was injected subcutaneously in the groin of each of two monkeys. Two days later both animals were quiet and were affected with diarrhœa. After further two days, the animals did not feed, had still diarrhœa, were quiet, and sat huddled up in the corner of their cage. One died on the eleventh the other on the fifteenth day, both remaining quiet and ill, and off their feed till the end. On post-mortem examination there was, in each instance, found in the groin at the seat of inoculation an open abscess; the lymph glands of the groin were swollen and purulent; the liver was enlarged, congested and showed about six to eight angular white nodules; the spleen was swollen and contained also a few white nodules. Film specimens of the spleen nodules (Fig. 7, Plate IV.), as also cultures from the nodules of the spleen and liver, showed the copious presence of the bacillus of pseudo-tuberculosis.

Inoculation into the *peritoneal cavity* of the guinea-pig of minute doses of virulent material, or of virulent agar culture causes a rapid and intense disease process, which in its general manifestations is the same as after subcutaneous injection. Thus, a guinea-pig having been injected intraperitoneally with a minute dose (emulsion) of an agar culture of the bacillus of pseudo-tuberculosis was found dead on the sixth day. The liver, spleen, omentum, and pancreas contained numerous minute white firm nodules, and these, when cut into, presented a necrotic tissue in which the microbe injected was abundantly present.

Intravenous injection of culture into the rabbit causes death between 48 hours and 72 hours. After death the lungs, liver, kidneys, and spleen are found much congested and more or less uniformly mottled. In sections of the hardened organs, particularly of the liver, numerous blood vessels (the interlobular veins and especially the intralobular capillaries) are found distended and plugged for considerable distances by continuous masses (emboli), made up entirely of the bacilli injected. Figs. 5 and 6, Plate III., show these bacillary emboli in the vessels of the liver, and around the emboli the liver tissue undergoing more or less distinct degeneration; indeed, in the liver freshly removed from the body (also in the spleen), one can distinguish under a glass vast numbers of minute specks, which are necrotic foci around the emboli in blood vessels.

The most striking results, however, are produced by *feeding* guinea-pigs with virulent material. These results have been already observed and described by A. Pfeiffer (loc. cit., p. 38).

If a recent broth or milk culture be added to and freely mixed with a little green food finely cut up, the guinea-pigs will take this very well. From a number of such experiments which I made, I quote the following :—

Two guinea-pigs were fed with mixture of green food and milk culture of the bacillus of pseudo-tuberculosis. Not till the ninth day was there anything abnormal noticeable. On that day, however, both were off their feed, were rather quiet, and had become thin. One killed at this date showed the following appearances :—In the wall of the ileum, and particularly in the Peyers glands, which were large and prominent, were numerous whitish-yellow caseous nodules, around which the tissue was much injected. The mesenteric glands were greatly enlarged and firm, and contained numerous whitish-yellow foci of caseation; notably in the neighbourhood of the ileo-cæcal valve (both in ileum and in cœcum) the Peyers glands and the lymph glands were much enlarged and exhibited whitish foci. The chyle vessels extending from the ileum to the mesenteric gland were marked by numerous beadings of firm white nodules. The spleen was enlarged and contained numerous white nodules. The liver was permeated by white nodules. On the peritoneal surface of the diaphragm, as also in the interior of the chest and on its pleural surface, there were numerous minute white nodules in the course of the lymphatics. In short, the manner of spread in this instance of the disease, in the form of whitish tubercles and nodules, from the lymph apparatus of the intestine—Peyers and solitary glands —to the lymph vessels of the mesentery, the mesenteric glands, liver and spleen and diaphragm, exactly simulated that met with in "feeding tuberculosis"; so much so, indeed, that no one looking at the appearances of the viscera of the above animal would for a moment have doubted that the disease was real tuberculosis. Yet, on bacteriological examination of the diseased tissues, not only was there a total absence everywhere of the real tubercle bacillus, but, on the other hand, the deposits contained an abundance of the bacillus of pseudo-tuberculosis.

The second of the guinea-pigs fed with mixture of green food and milk culture was found dead on the sixteenth day; and at post-mortem it presented appearances the same as those of the first guinea-pig. Fig. 2, Plate II., shows the nodular deposits in the ileum and coecum, along the mesenteric lymph vessels, the glands about the ileocæcal valve, and, mesenteric glands. Fig. 3, Plate II., shows the condition of the liver and spleen. As stated above, these two cases are only samples of a series of similar cases where cultures of the bacillus of pseudo-tuberculosis was used for infecting guinea-pigs by ingestion; the result having been in all instances very marked and positive.

C.—MICROSCOPIC APPEARANCES OF PSEUDO-TUBERCULOSIS.

The morbid deposits may be briefly described as round-cell infiltrations accompanied by rapid death and necrosis not only of the infiltrating material, but also of the normal tissue elements surrounding it:—the so-called "coagulation necrosis."

This last-named process is easily and distinctly observed in the liver. Fig. 8, Plate IV., shows the new growth as consisting of a dense infiltration of the interlobular connective tissue surrounding the interlobular large blood vessels and bile ducts, and extending as smaller or larger round cell masses into the adjacent liver lobules, thereby compressing the trabeculæ of liver cells and causing them to lose not only their outline but also their staining capacity. In Fig. 9, Plate V., there is shown a large nodule of which the centre is necrotic, caseous, and unstained, but also the figure shows a marginal part of dead liver tissue, in which the original arrangement of trabeculæ of the liver cells is still recognisable but in which the liver cells have not taken the stain. The most instructive specimens are those in which the sections are stained in a mixture of eosin and methylblue, the eosin staining the dead necrotic tissue, the blue the still living elements. Fig. 9, Plate V., is such a specimen, where the dead liver tissue composing the outer part of the nodules can be readily recognised by its pink colour. Fig. 10, Plate V., illustrates the earlier stages of the process, the liver being permeated by very numerous small nodules; in some of these (near the free surface) the necrotic centres (more transparent) are already indicated. As is also shown in this and the previous figures the nodules are by no means limited to the interlobular tissue and marginal parts of lobules, but appear in many places within the lobules. Fig. 11, Plate VI., shows necrotic patches of the liver of considerable dimensions; an interlobular artery and several distended interlobular bile ducts (marked by their epithelium) are to be here observed, around which all the new growth is practically necrotic. Adjoining it are big necrotic masses, in which only scattered nuclei are still recognisable. Fig. 12, Plate VI., shows the central part of a big necrotic nodule, the tissue (with the exception of scattered remnants of nuclei) being dead and not stainable by methylblue. Fig. 13, Plate VII., shows the central part of a nodule almost free of tissue elements, and containing only non-stainable dead debris with deeply stained, large and small, aggregations of the bacillus of pseudotuberculosis. This is a representation under a higher magnifying power of the central part of the big nodule of Fig. 9, Plate V.

Of the same character are the deposits in the spleen; viz., round cell masses with subsequent necrosis involving also necrosis of the surrounding tissue. It is not easy at first to ascertain the exact position of the nodules, viz., whether in the pulp tissue or in the Malpighian corpuscles; the spleen being as a rule everywhere so abundantly pervaded by the nodules. But on careful examination of early stages, the nodular masses are found as often, if not oftener, in the pulp tissue as in the Malpighian corpuscles.

As already mentioned, the *lung* shows also nodular deposits. Fig. 14 depicts one such nodule in the lung, which is seen to consist of a dense infiltration and filling in of the air cells and infundibula with round cells, the exudation extending into the tissue immediately surrounding the nodule. This is in effect a localised patch of pneumonia. In this case also the centre caseates, and becomes necrotic and white; and as will be mentioned presently contains large and small masses of the microbe.

The deposits in the wall of the *intestine* (solitary lymph glands and Peyers gland) resulting from feeding with bacillus of pseudotuberculosis present the same features. They consist in inflammation and enlargement of the lymph-tissue leading rapidly to necrosis of the enlarged lymph follicles, as is well shown in Figs. 16 and 17, Plate VIII. Large and small masses of the bacilli are found in the enlarged follicles in and around the necrosed parts.

A characteristic difference between the nodules of pseudo-tuberculosis and those of true tuberculosis is the absence in the former of the multi-nulcleated giant cells which are so readily found in true tubercles. The only instance in which I have, in pseudotuberculosis, found anything resembling pluri- and multi-nucleated cells was in the nodules of the spleen of the above mentioned monkeys. Here undoubtedly there could be found in the pulp tissue surrounding the nodules, cells which by their size and by their containing from two to six or eight nuclei must be considered as corresponding to the giant cells of true tubercle.

The histological differences between tubercle and pseudo-tubercle are not, it will be seen, so striking as to justify an off-hand differential diagnosis. For this it is necessary that the absence of giant cells in the nodules (in the guinea-pig), the absence of the true tubercle bacillus, and the copious presence of the bacillus of pseudo-tuberculosis should be established. This is the more important since pseudo-tuberculosis, like true tuberculosis, when induced by ingestion, involves the lymphatic apparatus of the ileum and coecum and the mesenteric glands, and spreads thence to other viscera. As a last differential character may be mentioned the more rapid development of pseudo-tuberculosis than of true tuberculosis.

D.—THE DISTRIBUTION OF THE BACILLI OF PSEUDO-TUBERCULOSIS IN THE MORBID DEPOSITS.

One chief and striking character of the bacillus of pseudo-tuberculosis is its intracellular distribution in the lymph glands, as also in the caseous and purulent nodules (often after subcutaneous, generally after intraperitoneal injection) in the omentum and pancreas. Film specimens made of the necrotic or purulent tissue of the swollen inguinal glands (after subcutaneous injection), or of the pelvic glands or mesenteric glands, or of the typical caseous-purulent nodules in the omentum (from the duodenum to the spleen alongside the large curvature of the stomach), show abundance of the bacilli lodged either in dense masses within swollen leucocytes, or occurring in groups occupying the disintegrated substance of what were once the bodies of leucocytes. There are also here and there groups of bacilli apparently lying free among granular debris, though from what has been just stated it is very probable that this debris is the remnant of leucocytes. As a matter of fact some of the leucocytes containing masses of the bacilli are so swollen, and their outlines rendered so indistinct, that their former character can only be diagnosed by their nuclei or what is left of nuclei. Fig. 18, Plate VIII., and Fig. 19, Plate IX., show these conditions in a necrotic-purulent inguinal gland after subcutaneous injection. And these conditions are even more striking in the nodules of the omentum and the pancreas. I would particularly draw attention to Fig. 20, and Fig. 21, Plate IX., as showing the copious presence of the bacilli within the protoplasm, or what was once the protoplasm, of leucocytes. Sections made through the hardened pancreas (when this is permeated by the nodules) show (Fig. 22, Plate X.), that the bacilli are almost entirely limited to the cells. Further, in good film specimens it is obvious that the bacilli within the leucocytes are aggregated in clumps or nests.

In the nodules of the liver and spleen, of the lung and intestine, the bacilli are present in large numbers. Film specimens made of the necrotic (white) parts always show the bacilli abundantly; as a rule in masses large and small, but also in small groups and as isolated bacilli, these latter particularly in the inflamed parts surrounding the actual necrotic nodule. This is well shown in sections of the hardened tissues. In sections through the spleen the larger masses of bacilli in the necrotic parts, and the smaller groups in the adjoining inflamed parts, are easily demonstrated. It is here that it can be ascertained that the small groups of bacilli are really located within the protoplasm of cells. In sections of nodules of the liver the chief masses of bacilli occur in the necrotic parts and extend, therefrom, outwards as smaller masses. But in the infiltrated tissue surrounding the necrotic parts, small groups of the bacilli are also met with. When any of the larger masses of the bacilli in the necrotic parts of the liver nodules are carefully scrutinised in well stained sections, it is seen that while the bacilli of the peripheral portions of the bacillary masses are of the typical oval or cylindrical shape and take the stain well, those in the central part of the bacillary mass are broad and do not take the stain or take it only feebly. It looks, therefore, as if here the bacilli were degenerated or dead, and that only their swollen sheaths are left (Fig. 23, Plate X., and Fig. 13, Plate VII.).

In the swollen and caseous lymph follicles of the intestinal wall (where the disease has been induced by ingestion) the massing together of the bacilli is always conspicuous (Fig. 17, Plate VIII.). And here is observed another interesting fact, viz., that the bacilli form convolutions and conglomerations of chains, such as is observed (see Fig. 33, Plate XIV., below) in broth cultures. The same holds good for the nodules of the lung (Fig. 14, Plate VII.). Not only are the bacilli there found in greater or smaller aggregations, but they are distinctly arranged in chains (Fig. 15, Plate VII.). This is easily verified at the marginal parts of the lung nodules, where the groups and masses of the bacilli are smaller and scantier. When the lung has become the seat of necrotic nodules and larger or smaller parts of the lung tissue are in an inflammatory state, the infundibula and large and small bronchi contain caseous purulent matter. In such matter, also, masses of bacilli are generally found in great number.

In the blood of the general circulation the bacilli are rarely met with, even though the animal, guinea-pig or rabbit, has died in ordinary course with extensive disease. In film specimens of the heart's blood this absence of bacilli is not matter for astonishment; but I must confess that I was rather surprised to find that even a good sized drop of the heart's blood from a guinea-pig in which the disease (caseous purulent nodules in the omentum, liver, spleen and lung and lymph glands) had become very extensive, yielded in culture either no colonies or very few only. Fig. 24, Plate XI., represents a culture on gelatine, which had been inoculated with a platinum wire from salt emulsion of a necrotic inguinal gland. In Fig. 25, Plate XI., is depicted a similar culture of bacillus pseudo-tuberculosis on gelatine, resulting from a large sized drop of blood taken from the heart of a guinea-pig, dying in three days. Such positive result in the case of blood is not, however, obtained when the animal lives beyond seven days and has the disease of the viscera well developed. I here give the results of several instances in which culture of the heart's blood (one good sized drop) was made.

(*a*) A guinea-pig, dead on the fifteenth day after subcutaneous injection and presenting numerous nodules in the spleen and liver. Heart's blood, one drop added to each of two gelatine tubes yielded in one tube no colonies, in the other one colony only.

(*b*) A second guinea-pig, dead on the ninteenth day and exhibiting pronounced disease of the inguinal and other lymph glands, omentum, liver, and spleen. Heart's blood culture negative.

(*c*) A third guinea-pig, dead on the sixth day and presenting numerous minute nodules in liver and spleen. Heart's blood culture negative.

More success is obtained in the guinea-pig with the heart's blood cultures after intraperitoneal injections. A guinea-pig injected intraperitoneally died on the sixth day, and exhibited typical but early disease in the omentum, pancreas, liver, and spleen. Culture of its heart's blood yielded 19, and another 26, colonies of the bacillus.

In the rabbit, also, the heart's blood appears free of the bacilli after subcutaneous injection; but after intravascular injection (in two animals which died, one on the third and the other on the fourth day) a big drop of blood yielded 28 colonies in the one animal; in another their number was fairly large.

As regards the mouse, I have already mentioned that these animals died of general septicæmic infection. Consequently their heart's blood contained the bacilli abundantly; they could be easily detected in stained film specimens in every field of the microscope. In the heart's blood of the monkeys mentioned on a previous page, no bacilli could be demonstrated by culture.

All morbid deposits, however, whether of guinea-pig, rabbit, or monkey, such as caseous-purulent foci and nodules of the lymphatic glands, of lymph vessels, of liver, spleen, or lung, yield cultures easily. And this even with a trace of the material. A platinum needle dipped into the necrotic or purulent portion of a lymph gland or into the spleen, and rubbed over the surface of gelatine or agar, yields large numbers of colonies of the bacillus of pseudo-tuberculosis. Similar material when used directly for stained film specimens shows the bacilli numerously.

The bacillus of pseudo-tuberculosis in the necrotic purulent nodules of the lymph glands of the omentum, liver, spleen, and lung, does not take the ordinary dyes well when ordinary (dried) film specimens of the fresh material are stained, unless indeed the specimens are kept in stain for some considerable time (hours), but in such cases all other parts also become deeply stained and differentiation of bacilli and tissue debris becomes therefore a matter of difficulty. The best specimens of fresh material are obtained by leaving the dried films in (alkaline) Löffler's methylblue for some time (15 to 20 minutes), and heating the latter to steaming point. By this method and by subsequent good washing in distilled water, the bacilli become well stained and differentiated from the tissues. By prolonged washing the bacilli often show polar stained granules and a clearer central part. Figs. 19, 20, 21, Plate IX., already referred to show the bacilli stained deep blue. Sections of hardened materials (which have been placed in Müller's fluid and then subjected to the usual spirit hardening) can be stained more easily, but here also prolonged staining (24 to 48 hours) in Löffler's methylblue, and particularly prolonged staining (1 to 2 days) in a mixture of eosin and methylblue (as already mentioned) yield the best results. A. Pfeiffer (loc. cit. p. 14) did not succeed in staining the bacilli after Gram's method. I think this must have been due to some defect in the method used, because the bacilli in the tissues can be readily stained by Gram's method either as dried films of the fresh, or as sections of the hardened, material. For instance—One minute in strong alcoholic solution of gentian violet anilin water, four minutes in the usual iodine potassium-iodide solution, then after washing counterstaining in Bismark brown. By this process the bacilli will be stained, although not always quite so deep a blue as in the case of many well known Gram stained bacilli. Film specimens also of culture of the bacillus of pseudo-tuberculosis treated in this way exhibit bacilli which remain stained with the gentian violet. Figs. 7, Plate IV., and 32, Plate XIV., are from Gram stained specimens.

E.—The Cultural Characters of the Bacillus of Pseudo-tuberculosis.

I have already observed that these bacilli are abundantly present in the necrotic-purulent foci of the lymph glands, liver, and spleen. In order to obtain pure cultures of the bacillus in isolated colonies, all that is necessary is to take a particle of such necrotic or purulent matter, to shake it up in a few cc. of sterile salt solution, and to rub a droplet of this with a platinum loop over the slanting surface of gelatine (Fig. 24, Plate XI.,) or agar contained in a test tube, or over the flat surface of a gelatine or agar (Figs. 26, 27, 28, Plates XI. and XII.), plate. As has been already mentioned (Fig. 25, Plate XI.), culture from the blood is successful only in the early stages of the disease, or when the animal (guinea-pig) has died within a week of subcutaneous, better still of intraperitoneal, injection.

(a) *Plate cultivation.*—By spreading out by means of a platinum spatula on the surface of gelatine (previously set in a sterile plate-glass dish) a drop of the dilution just now mentioned, and incubating at 20° C., colonies of the bacillus become visible to the unaided eye in 48 hours. They appear as minute, flat, grey dots, which, under a magnifying glass, appear disc-shaped with angular outline, thin filmy margin, and a thicker less transparent slightly raised centre (Fig. 26, Plate XI.). As a matter of fact the colonies resemble in a marked degree those of B. coli, or coli-like microbes. In Fig. 27, Plate XII., colonies of the bacillus of pseudo-tuberculosis are seen magnified 18 times, and their similarity to those of B. coli and its varieties is unmistakeable. But

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as growth proceeds, and after about a week, the colonies of the bacillus of pseudo-tuberculosis are more opaque, whiter in reflected light, and less spread out than those of B. coli under similar conditions. The gelatine is not liquefied by the growth.

Similar surface plates on agar show colonies (Fig. 28, Plate XII.) also like those of B. coli; namely, a moist, round, flat, only slightly raised disc, with here and there slight irregularities of edge.

(b) *Streak cultures* on gelatine (Fig. 29, Plate XIII.) and on agar show similar resemblance to those of B. coli, with the difference, however, that in the case of the bacillus of pseudo-tuberculosis the growth is not so spread out as that ofB. coli.

(c) *Stab cultures* in gelatine (Fig. 30 and Fig. 31, Plate XIII.) and agar exhibit a series of minute more or less confluent dots along the track of the needle, and there is a small disc-shaped expansion at the upper end of the stab. In the case of B. coli there would be, on the contrary, a broad irregularly outlined expansion covering almost the whole surface of the gelatine at the upper end of the stab. There is no trace of gas-bubbles in connexion with the deeper colonies in the case of the stab culture of the bacillus pseudo-tuberculosis, whereas in that of B. coli there would be one, two, or several gas-bubbles extending laterally from the line of growth. The difference from typical B. coli is, however, distinct in *shake culture* in ordinary and in sugar gelatine. In shake culture the developing colonies of B. coli in the deeper parts are associated with gas-bubbles, whereas those of the bacillus pseudo-tuberculosis never form gas bubbles, either in ordinary gelatine or in grape sugar gelatine. It has to be remembered, however, that there are known several varieties of B. coli which do not form gas-bubbles in shake culture. The gelatine is never liquefied.

(d) *Broth and litmus broth* furnish the best and easiest ascertained cultural difference between the bacillus of pseudo-tuberculosis and B. coli and its varieties. B. coli and its varieties form acid distinctly and rapidly under these conditions, and therefore quickly turn the original blue (alkal.) litmus broth distinctly red. The bacillus pseudo-tuberculosis does not do this; on the contrary, it makes the at first faintly alkaline broth and litmus broth distinctly and more pronouncedly alkaline. Starting, for instance, with broth so faintly alkaline that litmus is just blue, after several days' growth the litmus broth becomes deep blue.

Another important difference with regard to broth cultures is this:—B. coli and its varieties make the broth (incubated at 37° C.) uniformly turbid in 24–36 hours, whereas the bacillus pseudo-tuberculosis does not do this; the broth remains clear, and shows granular and floccular, grey, stringy, whitish masses at the bottom and along the sides of the tube. These flocculi and granules under the microscope are made up of aggregations and conglomerations of bacillary chains (Fig. 33, Plate XIV.), which easily break up into short chains and individual bacilli. After several days' growth there is an indication of an imperfect pellicle on the surface of the broth.

A further distinguishing character between bacillus pseudo-tuberculosis and B. coli is that the former does not form indol in broth culture.

(e) In *milk* the bacillus pseudo-tuberculosis grows well; but it leaves the milk unaltered, no curdling takes place, and litmus milk retains its deep blue colour.

(f) On *potato* sterilized, the growth is somewhat limited; it is a faintly brownish thin layer, with somewhat thicker crenated whitish yellow margin (Fig. 4, Plate II.).

(g) The bacillus pseudo-tuberculosis grows well on solidified *blood serum* with appearances similar to those on the surface of agar. The serum is not liquefied.

F.—THE MORPHOLOGY OF THE BACILLUS OF PSEUDO-TUBERCULOSIS.

On examining under the microscope the microbe as it appears in the colonies on gelatine, it is found to consist of distinctly cylindrical rods with rounded ends. In the hanging drop they are as a rule without motility, but here and there something resembling a motile rod can be made out. On staining for flagella, after Van Ermengem's method, with nitrate of silver, there is met with here and there a rod possessed of a terminal filamentous flagellum, some few even with two flagella at one end.

The bacilli are most typically cylindrical in recent colonies on gelatine:—*See* Fig. 34, which shows the bacilli in an impression specimen from a colony on this medium. Measurements of the bacilli from a specimen of this character show the following:—

Length of the bacilli	1·2 — 1·8 — 2 μ
Thickness	0·4 — 0·5 μ

Film specimens of recent agar cultures show the majority of the bacilli to be shorter than on gelatine; oval or even spherical bodies, like cocci, are met with; some few are cylindrical or even filamentous (Fig. 32). Measurements made of such specimens show that the majority of the short oval rods are:—

0·8 — 1·0 μ in length.
0·5 — 0·6 μ in thickness.

This shorter form of the average microbe on agar resembles more those occurring in the tissues, as already described. The filamentous chains formed by the bacilli in broth cultures, in the lungs, and in intestines have also being already referred to, and need not be further described.

In describing the cultural and morphological characters of the bacillus of pseudo-tuberculosis certain resemblance to the B. coli have been noticed, as also other definite characters by which the two can be readily distinguished from one another. But the easiest and best distinction between them is animal experiment. For as I have pointed out even a small amount of the recent growth of bacillus of pseudo-tuberculosis causes on subcutaneous injection into the guinea-pig (and better still by feeding the animal with it) typical nodular necrotic purulent changes in the lymph glands, omentum, pancreas, liver, and spleen, and finally also the lung, an effect which B. coli or its varieties does not produce.

It is necessary to bear in mind that the bacillus of pseudo-tuberculosis is, as I have shown, liable to occur in sewage, in water polluted with sewage, and in some cases in shop milk. Hence in regard of these substances it is not safe from mere appearances on gelatine to regard particular colonies as those of B. coli or its varieties. Such colonies cannot, without animal experiment, be declared not to be bacillus of pseudo-tuberculosis. Moreover, they may be neither B. coli or its varieties, nor bacillus of pseudo-tuberculosis. For instance, in sewage there may be present a microbe which to a certain extent resembles, and in other respects markedly differs from, not only bacilli of the coli group, but also the bacillus of pseudo-tuberculosis, namely, a pathogenic microbe, which was isolated by animal experiment from ordinary domestic sewage. This I have termed *bacillus pyogenes cloacinus.*

Bacillus Pyogenes Cloacinus.

The Figs. 35, 36, 37, 38, and 39, Plates XIV. and XV., show this microbe in the leucocytes of the local (inguinal) abscess after subcutaneous injection of sewage; in the swollen leucocytes of the pyogenic membrane of the peritoneum and also free in the purulent fluid of the peritoneum; in the leucocytes and fluid of pericardial pus; and particularly in the swollen leucocytes of the pyogenic membrane in the pleural pus. Figs. 40, 41, 42, 43, and 44, Plates XVI. and XVII., show the appearance of the colonies of this bacillus in gelatine cultivations, both in their natural size and under magnification, in streak and stab culture. Fig. 45, Plate XVII., shows in an impression specimen a very young colony on gelatine 1,000 times magnified. The constituent bacilli are here seen to be of length varying from very short ovals to longer, distinctly cylindrical bacilli. The morphological, cultural, and pathogenic characters of this microbe are so definite and distinct that a differentiation of it from either B. coli or the bacillus of pseudo-tuberculosis is possible without much difficulty.

G.—EXPERIMENTS ON PROTECTION IN PSEUDO-TUBERCULOSIS.

1. *Experiments with Minute Sub-fatal Doses of Living Culture.*

The first series of experiments were made for the purpose of ascertaining whether guinea-pigs that had suffered from the disease, but had recovered, were in consequence furnished with power to resist a second infection with an otherwise fatal dose of living culture. It had been noted in the course of experiments with recent and old cultures that in some instances (a minimal dose of the former or a somewhat larger dose of the latter being employed for inoculation) the animals develop the local necrotic purulent tumour containing abundance of the typical bacilli; but that this tumour, after spontaneously opening and discharging, becomes an open sore, which gradually though slowly heals completely; the animals after this remaining apparently in good health. Several such animals in the course of this inquiry became available for further experiment, and accordingly were again subjected to a subcutaneous injection (in the other untouched groin) with an ordinarily fatal dose. The result was negative—that is to say, the animals remained well.

It is impossible to define the maximum of *recent* culture which on injection will fall short of setting up visceral disease and death, because, as previously mentioned, very minute doses generally produce the latter result. In the course of numerous experiments with subcutaneous injection of minute doses, some animals only, and these for indefinable reasons, escaped with mere local disease and seemingly quite recovered. Here, on the other hand, is an experiment, showing how small doses of recent culture are capable of causing the local and general disease with fatal issue. Of a 48 hours' old agar culture, one twenty-fifth to one-thirtieth part was subcutaneously injected into the groin of each of three guinea-pigs of about 350 grammes weight. The animals died on the seventh, ninth, and tenth days respectively, each with pronounced disease of the lymph glands, liver, and spleen.

It was therefore deemed advisable to use for protective inoculation small doses of *old* cultures, these having been found by previous experience to be less prone to be productive of the general disease and fatal result.

From an agar culture, therefore, four months old, a platinum loopful of the growth was taken and distributed in a cubic centimetre of sterile salt solution. The emulsion thus obtained was then used for subcutaneous injection of four guinea-pigs (Nos. 61, 62, 63, and 64). One of these guinea-pigs (No. 61) was found dead on the 12th day; it showed pronounced necrotic changes in the enlarged inguinal glands, and numerous necrotic nodules in the liver and spleen. The other three guinea-pigs each developed a big firm tumour in the groin of the injected side; the animals, however, remaining lively and well. The four tumours suppurated and ulcerated, and ultimately, by the end of the third week, had quite healed up.

Several guinea-pigs that had thus passed through and recovered from a first sub-fatal injection were now injected again with an ordinarily fatal dose (as proved by control animals). But no local tumour and no general disease was thereby caused, and the animals remained well, thus proving that they had been effectually protected by the first injection.

2. *Experiments with Sterilised Culture.*

A number of preliminary experiments were made in order to ascertain at what degree of heat the bacilli become killed.

(*a*) Broth culture that had been growing for some days and which showed good growth (granules and flocculi at the bottom of the fluid as also on the sides of the flask) was used for making subcultures on agar and in, broth. It was then exposed for five minutes to a temperature of 70° C. After this it was cooled and was used again for making further subcultures on agar and in broth. As a result it was found that while the subcultures made from the broth culture before heating yielded positive result and good growth, those made after the heating remained sterile. It appeared therefore that exposure to 70° C. for five minutes effectually kills the bacilli.

(*b*) The growth was scraped off from the surface of agar and gelatine cultures and distributed separately in 5 to 6 cc. of sterile salt solution, and the emulsion thus obtained was then heated for five minutes at 70° C. Subcultures made from the emulsion before heating yielded good and copious growth, whereas those made after the heating remained sterile. So that here also exposure to 70° C. for five minutes destroyed the vitality of the bacilli. The next step was to inject sterilised cultures of the above kind.

Series I.—Two guinea-pigs (*a*) and (*b*) each received subcutaneously into the groin one-sixth of an agar surface culture (48 hours old) sterilised in the above fashion. Two other guinea-pigs (*c*) and (*d*) each received intraperitoneally one-sixth of same sterilised culture. Next day all four animals were quite lively and fed well, though in the evening of the day of injection (*a*) and (*b*) had seemed quite unaffected while (*c*) and (*d*) were a little quiet. All remained quite well subsequently, and the subcutaneously inoculated animals showed no tumour in the groin.

On the eighth day, being quite normal, these animals were re-injected in the same way as before, viz. (*a*) and (*b*) subcutaneously, and (*c*) and (*d*) intraperitoneally, each animal receiving on this occasion half to two-thirds of an agar culture (48 hours old) sterilised. By this re-injection, the subcutaneously inoculated animals (*a*) and (*b*) were in no way affected; those intraperitoneally injected (*c*) and (*d*) were however quiet on the evening of the day of injection. One of them (*c*) had quite recovered next morning, the other (*d*) was still a little quiet and did not feed normally. On the sixth day, all four animals being now quite normal (those subcutaneously inoculated showing no tumour at all), the injection was repeated. Animals (*a*) and (*b*) received each about half of a sterilised agar culture (48 hours old) subcutaneously; (*c*) and (*d*) the same amount intraperitoneally. The result was nil. All the animals remained well and fed well; one only of those subcutaneously inoculated showed on the sixth to seventh day after this third injection a small firm nodule just traceable in the groin by careful examination.

All four animals, after the lapse of 12 days from the last injection, were submitted to injection subcutaneously in the groin with an ordinarily fatal dose* (one-twentieth of a 48 hours' old culture) of living agar culture. The result was curious. On the fifth day all four had a big firm tumour at the seat of the last injection with living culture; but while the two guinea-pigs (*a*) and (*b*) (protected subcutaneously) were lively and fed well, the other two (*c*) and (*d*) (protected intraperitoneally) were quiet and did not feed quite normally.

Guinea-pig (*c*) was found dead on the eighth day, and examination (post-mortem) revealed the typical appearances of pseudo-tuberculosis in the inguinal glands, liver and spleen. Cultures made from the nodules of these organs yielded copious colonies of the bacillus of pseudo-tuberculosis of normal virulence. The second intraperitoneally protected guinea-pig (*d*), and the two subcutaneously protected guinea-pigs (*a*) and (*b*), had, when examined on the twelfth day, each a big suppurating tumour discharging on to the free surface thin serous pus; they were otherwise lively and fed well. On the forty-first day these three remaining animals were lively; they were growing fat, and showed at the seat of the former tumour a trace of healing ulceration. Four months after the last injection with living culture they appeared perfectly normal in every respect, having increased in weight to a considerable degree.

It follows then that by means of thrice repeated *subcutaneous* injection of sterile culture (one-sixth, half, two-thirds, and half agar culture respectively) both experimental animals had been furnished with the ability of resisting the effect of a living culture which in a control animal had produced the typical and fatal disease; nothing beyond a local effect (tumour and suppuration) was caused in the animals thus protected. As regards the *intraperitoneally* injected animals, since of the two guinea-pigs protected in this way only one survived subsequent injection with living culture, it is to be inferred that subcutaneous injection of sterilised cultures is, for protective purposes, more efficacious than intraperitoneal.

Series II.—In this series broth culture, sterilised, was used as the fluid for protective inoculation. This also was administered several times; in one set of animals *subcutaneously*, in the other *intraperitoneally*. But the result was disappointing.

Broth cultures that had been growing for nine days were sterilized at 70° C. for five minutes, and one cubic centimetre of this sterilized fluid was injected subcutaneously into each of two guinea-pigs (*e*) and (*f*). At the same time two other guinea-pigs (*g*) and (*h*) were intraperitoneally injected, each with one cubic centimetre of the sterilized broth. All four animals were thus dealt with on three separate occasions within eight days. None of the animals seemed in the least affected after these injections.

Ten days after the last injection all four animals, being seemingly quite normal, were each injected subcutaneously in the

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* As proved on a control animal.

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groin with an otherwise fatal dose of *living* agar culture ($\frac{1}{20}$ of a 48 hours' old culture). On the fifth day each had a big tumour at the seat of the injection. One of the intraperitoneally "protected" animals (*g*) died on the sixth day, with the general appearances of pseudo-tuberculosis; the other intraperitoneally "protected" guinea-pig (*h*) died on the fourteenth day, the appearances being typical pseudo-tuberculosis. Of the two subcutaneously "protected" guinea-pigs, one (*e*) died on the fifteenth, the second (*f*) on the seventeenth day. In both pseudo-tuberculosis was very pronounced in the lymph glands, liver, and spleen, as well as in the lungs.

From this it follows that a threefold injection of sterilized broth culture (3 cc. in all for each animal) did not materially affect the susceptibility of guinea-pigs to subsequent infection by an ordinarily fatal dose of living culture.

H.—RELATION OF TUBERCULOSIS TO PSEUDO-TUBERCULOSIS.

Having established various points and appearances by which these two diseases, when induced separately in guinea-pigs, can be distinguished, and knowing also in what respects they bear an undoubted resemblance, it seemed worth while inquiring whether these two diseases are capable of exerting influence one upon the other when both are induced in the same animal.

Series A.

Four guinea-pigs (Nos 1, 2, 3, and 4) were injected subcutaneously on May 29th with tuberculous matter derived from the human lung. Matter scraped from the caseous nodules and patches of a typical tubercular lung was uniformly distributed in a few cubic centimetres of sterile salt solution, 0·25 cc. of which was injected into each of the above four guinea-pigs. The emulsion in question, when examined under the microscope, showed in stained specimens great abundance of typical tubercle bacilli.

On the 13th day (*i.e.*, June 10th) all four guinea-pigs had much swollen firm inguinal glands on the injected side. One of them (No. 1) was now left for control, while the other three were injected, each in the other groin, with 0·25 cc. of a salt emulsion of an agar culture (48 hours' old) of the bacillus of pseudo-tuberculosis. At the same time one control guinea-pig (No. 5) was injected with a like dose of the same emulsion of bacillus pseudo-tuberculosis. The result was as follows:—

The first tubercle control guinea-pig No. 1 was killed on July 4th (*i.e.*, after 36 days); it had suppurating inguinal glands and tubercular nodules in liver, spleen, and lung, all of them containing the typical true tubercle bacilli.

Guinea-pig No. 2, inoculated with tubercle on 29th May and with pseudo-tubercle June 10th, died on June 15th. Post-mortem, the inguinal glands on the tubercle-inoculated side were enlarged,

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and contained a fair number of tubercle bacilli; on the pseudo-tubercle-inoculated side no enlarged inguinal glands were discovered. There was peritonitis with fluid exudation; the liver and spleen were covered with pseudo-membrane; the pancreas and omentum were each a continuous mass of pseudo-tubercles. The peritoneal fluid, the pseudo-membrane of the liver and spleen, as also the nodules of the pancreas, contained in abundance the bacillus of pseudo-tuberculosis, but not any tubercle bacilli.

Guinea-pig No. 3, inoculated with tubercle May 29th and with pseudo-tubercle June 10th, died on June 26th. Post-mortem, on pseudo-tubercle-inoculated side the inguinal glands were enlarged, with open abcesses; the liver and spleen showed very numerous nodules; the lung also numerous nodules. On the tubercle-inoculated side the inguinal glands could not be found. Sections made through the liver, spleen, and lung showed only abundance of bacillus of pseudo-tuberculosis in the nodules; no tubercle bacilli could be detected.

Guinea-pig No. 4, inoculated with tubercle 29th May and with pseudo-tubercle June 10th, died August 2nd. Post-mortem, little was found of the tubercle and pseudo-tubercle inguinal tumours, traces only of ulceration. The liver, spleen, and lung were riddled with nodules and patches. Sections through these showed bacillus of pseudo-tuberculosis present abundantly; also numerous tubercle bacilli.

Guinea-pig No. 5, inoculated with pseudo-tubercle alone on June 10th, died July 1st. Post-mortem, the appearances were typical of pseudo-tuberculosis.

The experiments then of Series I. go to show that previous injection with tubercle does not affect the development of pseudo-tuberculosis on subsequent injection with the bacillus of pseudo-tuberculosis. Further, they indicate that in an animal the inguinal gland of which is (after subcutaneous injection in the groin with tubercle) developing tubercle, injection of bacillus of pseudo-tuberculosis causes the development, within 16 days, of the necrotic nodules in liver, spleen, and lung, which nodules contain *only* the bacillus pseudo-tuberculosis, no tubercle bacilli being present. Lastly, it appears that if the animal lives long enough (animal No. 4, for instance) these nodules in liver, spleen, and lung will also contain tubercle bacilli.

Series B:

Four guinea-pigs (Nos. 6, 7, 8, and 9) were injected on July 4th, each in the right groin, with emulsion of a typical tubercular lymph gland.* This emulsion contained abundance of tubercle bacilli, and each of the guinea-pigs received ¼ cc. of the material.

On July 20th they all had swollen firm lymph glands on the inoculated (right) side. One (No. 6) was left for control, the other three were now injected in the left groin with an ordinarily fatal

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* Obtained from the tubercle-control guinea-pig No. 1 of first series.

(as proved by control animal) dose of an agar culture (48 hours' old) of bacillus of pseudo-tuberculosis.

On August 2nd (*i.e.*, 13 days after injection with pseudo-tubercle and 29 days after injection with tubercle) all four guinea-pigs showed tubercular inguinal glands in the right groin. The control animal No. 6 showed in addition an open abscess in right groin. The three guinea-pigs that had been injected with pseudo-tubercle in left groin showed each in that groin a big tumour as big as a filbert.

The control tubercle guinea-pig No. 6 was still alive on September 5th, *i.e.*, after two months. It was now killed, and showed typical tubercles in the liver, spleen, and lung—with tubercle bacilli.

Guinea-pig No. 7 died on August 8th. On left side (that on which pseudo-tubercle was inoculated) there was a big open suppurating ulcer and enlarged lymph glands; also there was on the right (tubercle) side a fair sized inguinal gland; the liver and spleen were pervaded by white nodules and patches; in the lungs also were some nodules. Sections through these organs showed abundance of bacillus of pseudo-tuberculosis in the necrotic nodules and patches, and in addition a fair number of tubercle bacilli. But these latter were not found in the necrotic parts; for instance, in the liver the nodules and patches contained an abundance of bacillus of pseudo-tuberculosis, whereas the tubercle bacilli could be found only in the interlobular infiltration. In the spleen there were only few tubercle bacilli present, and in the lung only pseudo-tubercle bacilli could be found in the caseous nodules; no tubercle bacilli could there be detected. The inguinal gland of the right (tubercle) side contained in its caseous matter numerous tubercle bacilli.

Guinea-pig No. 8 died on August 10th. The general appearances as to the inguinal glands of the two groins, liver, spleen, and lungs were almost identical with those of guinea-pig No. 7. Sections, however, made of the hardened liver and lung of guinea-pig No. 8, showed the typical masses of bacillus of pseudo-tuberculosis only; no tubercle bacilli. The spleen, in addition to the bacillus of pseudo-tuberculosis, showed also a few tubercle bacilli scattered through the pulp.

Guinea-pig No. 9 died on August 11th. The appearances as to the inguinal glands of the left (pseudo-tubercle) side and as to the liver, lung, and spleen, were very much the same as in the other two animals. The lymph gland of the right (tubercle) side was, however, only slightly enlarged. Sections through the liver, spleen, and lung showed abundance of bacillus of pseudo-tuberculosis in the necrotic nodules and patches. But no tubercle bacilli could be discovered in any of these organs. The inguinal glands of the right (tubercular) side, however, showed a fair number of tubercle bacilli.

These three guinea-pigs then, Nos. 7, 8, and 9, died with well-pronounced pseudo-tuberculosis after 19, 20, and 21 days respectively; in about the time that a control pseudo-tubercle guinea-pig also died. The post-mortem appearances moreover in this control case—suppurating inguinal swollen lymph glands, nodules in liver, spleen, and lung—were indistinguishable from those presented by the guinea-pigs Nos. 7, 8, and 9.

The first of these (No. 7) had no tubercle bacilli in the diseased parts of the lung, a small number only of tubercle bacilli in the spleen, and a fair number of tubercle bacilli in the tissue between the necrotic nodules of the liver. The second (No. 8) had no tubercle bacilli in the liver or lung, although both contained caseous nodules and patches; but it showed some few tubercle bacilli in the spleen pulp. The third (No. 9) showed no tubercle bacilli in the nodules of any of the viscera, but these contained numerous masses of bacillus of pseudo-tuberculosis. Indeed, if it had not been for the presence of a small gland, containing tubercle bacilli, in the right groin, where the first injection with tubercle had been made, no one could have said that this animal had been at all subject to injection with the tubercle bacillus.

Guinea-pigs Nos. 7 and 8 might have easily been regarded—from the appearances presented by the right inguinal gland containing caseous masses with tubercle bacilli—as having died from pure tuberculosis affecting the liver, spleen, and lung; particularly as the spleen (of No. 8) and the liver and spleen (of No. 7) did contain tubercle bacilli. But as a matter of fact the detailed examination that was made proved them to have been affected principally with pseudo-tuberculosis.

This series of experiments is then quite in harmony with those of Series I. and serves to illustrate in an instructive manner the care required when making differential diagnosis of tubercle and pseudo-tubercle. It has been recorded earlier in this paper, that on testing by animal experiment 96 samples of milk; pseudo-tuberculosis was produced six times in the viscera of the inoculated animals; wherefore, since it is well known that milk may and does sometimes contain the tubercle bacillus, it is quite possible a sample of milk might contain both the bacillus of true tubercle and the bacillus of pseudo-tubercle. If such milk were inoculated into the subcutaneous tissue of a guinea-pig, this animal would probably develop both tubercle and pseudo-tubercle; and further, the lymph gland of the groin of the inoculated side (provided the animal lived long enough) might be showing the tubercle bacilli (it always takes ten to fourteen days before this can be expected), whereas the liver and spleen would be containing nodular caseous masses free of tubercle bacilli, but pervaded by the bacillus of pseudo-tuberculosis. As a matter of fact I have had a guinea-pig dying of pronounced pseudo-tuberculosis within nine days of subcutaneous injection with a sample of milk.

Another instructive fact arises from the above experiments. It is seen that when after injection with true pulmonary (human) tubercle, a guinea-pig is injected with pseudo-tubercle, the animal will, within 16 days and before the true tubercle has had time to produce much change,* pre-eminently develop, and will die from, the rapid process of pseudo-tuberculosis. It would seem also as if the first established tubercular process becomes retarded to a certain extent by the more rapidly progressing pseudo-tuberculosis; and that the antecedent tubercular process does not seem to have any marked effect in enhancing or inhibiting the subsequently induced pseudo-tuberculosis.

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* I have shown in a former Report, 1886–1887, that human tubercle works much slower than bovine tubercle in the guinea-pig.

Series C.

This series comprised six guinea-pigs; namely, three the subjects of previous experiment, one which I term No. 47, and two control animals.

The three guinea-pigs of previous experiment are those referred to at p. 376, under the letters *a*, *b*, and *d*, as having by three previous injections of sterilized culture of bacillus pseudo-tuberculosis been rendered resistant against a subsequent injection with an ordinarily fatal dose of the living culture of this microbe, and as having completely recovered from the local tumour and ulceration caused by the latter injection.

Guinea-pig No. 47 had, with a companion No. 46, been fed (on June 14th) with green food with which had been mixed broth and gelatine cultures of bacillus of pseudo-tuberculosis. Both animals (46 and 47) were, on June 19th, noticed to be quiet and off their feed. On June 29th No. 46 was found dead, and, as post-mortem examination showed, presented necrotic nodules in the Peyer's glands and lymph follicles of the ileum, at the ileocæcal valve, in the coecum, in the mesenteric chyle vessels, in the mesenteric glands, in the lymph vessels of the diaphragm, in the liver and spleen. Its companion, No. 47, was, at this date, still quiet and off its feed, but got gradually better, and had seemingly completely recovered by the middle of July. It may be considered to have been infected with, and to have recovered from, the disease pseudo-tuberculosis; for it is not probable that of two guinea-pigs fed on a very large dose of the material, one should succumb to fatal advanced pseudo-tuberculosis and the other should escape altogether. As a matter of fact, indeed, No. 47 was affected; it was quiet and ill, and did not feed, from the sixth day onwards, after administration of the virus; it was in the same state on the sixteenth day, but then got better, and got finally seemingly all well again.

The material for inoculation experiments in this Series III. was obtained from a guinea-pig inoculated on September 19th with tubercle of another guinea-pig, and killed on October 16th. It had served as one of a series in carrying on from animal to animal the disease true tubercle originally started with human tubercle lung. This guinea-pig's inguinal glands showed the characteristic tumour and caseous masses, containing abundance of tubercle bacilli. An emulsion having been made of its inguinal glands, 0·25 cc. of this emulsion was in each instance subcutaneously injected into the groin of the above-mentioned guinea-pigs (*a*), (*b*), (*d*), and No. 47, and at the same time a similar amount was employed for the injection of the two control animals.

On October 26th, 10 days later, all these six animals showed firm inguinal glands on the injected side. On November 1st (after 16 days), the inguinal glands of the two control animals did not seem to have advanced in size, but in the four other animals they were in each instance nearly as big as a bean. On November 7th (after 22 days), guinea-pigs (*a*) and (*b*) had open suppurating inguinal glands; guinea-pigs (*d*) and 47 had tumours as big as filberts; one of the control animals had a tumour about as big as a small bean; and in the other control animal the inguinal gland could just be felt as a firm nodule.

Guinea-pig, No. 47, died November 16th. Post-mortem, there was intensive and extensive tuberculosis of omentum, pancreas, liver, spleen, pleura, and lung; the deposits in all these organs (inclusive of the caseous suppurating inguinal glands) containing abundance of tubercle bacilli.

Guinea-pig (*a*), died on December 12th. Post-mortem, the inguinal glands, liver, spleen, and lung contained numerous caseous foci with abundance of tubercle bacilli.

Guinea-pig (*d*), died on December 23rd, and showed typical advanced tubercle of omentum, pancreas, liver, spleen, and lungs; the necrotic masses of the inguinal lymph glands and of the viscera contained abundance of tubercle bacilli.

Guinea-pig (*b*), died January 19th, and showed post-mortem typical and extensive tubercle.

The two control guinea-pigs showed the tubercular charges usual in such animals; but with the difference, as compared with the other four animals, that in the control guinea-pigs the tubercular process seemed, if anything, less extensive. I find, for instance in my notes that one of these control animals, killed on December 15th, showed in the liver and spleen only a few tubercles (with the tubercle bacilli); no tubercles were present in the lungs; the inguinal glands, which had not suppurated yet, contained caseous foci, with abundance of tubercle bacilli. Considering that all these six guinea-pigs, *a*, *b*, *d*, and 47 (which had recovered from pseudo-tubercle) and the two control animals, had been injected with exactly the same amount of tubercular virus, and since the four animals of experiment, or at any rate some of them (No. 47, *a* and *d*), died of the induced malady before or about the same time that the control guinea-pigs had to be killed, and that they showed a very extensive tubercular process, it would seem that not only had their recovery from a local pseudo-tubercular process not interfered with the subsequent development in them of tuberculosis, but that on the contrary it had favoured the progress of the latter disease.

Series D.

Three guinea-pigs, Nos. 1, 2, 3, were injected subcutaneously in their right groins, each with a minute dose of an emulsion from an old agar culture of the pseudo-tuberculosis bacillus. All three animals had six days later big, firm inguinal tumours on the right side, but were otherwise lively, and they fed well.

App. B, No. 1.
On Pseudo-tuberculosis, its Pathology and Etiology: by Dr. Klein, F.R.S.

On the 20th day the inguinal tumours having rather diminished they, and in addition two fresh control guinea-pigs, were injected with tubercle. The caseous portions of the swollen inguinal glands of a stock tubercle guinea-pig were rubbed up in a sterile glass mortar in sterile salt solution, and a uniform turbid emulsion made. Microscopic specimens of this emulsion showed abundance of tubercle bacilli in every droplet. Each of the above three guinea-pigs, Nos. 1, 2, 3, and the two control animals, received 0·25 cc. of this emulsion subcutaneously in the left groin. As a result, one of the control guinea-pigs died 44 days after injection with tubercle. On post-mortem examination it showed the typical caseous inguinal lymph glands, and an open ulceration on left side. The liver, spleen, and lung were riddled with tubercles containing abundance of the tubercle bacilli. The second control guinea-pig died 61 days after the injection with tubercle. On post-mortem examination it showed much enlarged caseous inguinal lymph glands, and an open sore on the left (injected) side. The liver, spleen, pancreas, and lung showed very advanced tubercles with numerous tubercle bacilli.

The three guinea-pigs however, Nos. 1, 2, 3, which had received previously a dose each of attenuated pseudo-tubercle culture, were found 94 days after the second (or tubercle) inoculation to be in fair condition; they were lively and feeding well. They were now killed and presented the following appearances on post-mortem examination :—

Guinea-pig 1.—The right groin (site of pseudo-tubercle inoculation) was free from any tumour or enlarged lymph glands. On the left (tubercle) side this guinea-pig showed an open sore in the groin and a small caseous lymph gland. The spleen contained about six purulent nodules; liver was free of tubercles in the right and middle lobe, the left lobe had about four small tubercles. Both lungs contained a few tubercles. Microscopic specimens showed a fair number of tubercle bacilli in the inguinal gland of left side. The purulent matter of the spleen tubercles showed few tubercle bacilli only; so also the tubercles of the liver and lung. No pseudo-tubercle bacilli to be discovered anywhere.

Guinea-pig 2.—The right groin (site of pseudo-tubercle inoculation) free from tumour or enlarged lymph glands The left side (site of tubercle inoculation) showed a small open but healing sore attached to a small purulent lymph gland. The spleen was only slightly enlarged, and contained about half-a-dozen tubercles not bigger than millet seeds. The liver seemed normal and free of any nodules. One lung had two, the other three small tubercles. Microscopic specimens showed few tubercle bacilli in the purulent matter of the inguinal gland and in the nodules of the spleen. The like was the case as regarded the nodules of the lung. No pseudo-tubercle bacilli to be discovered anywhere.

Guinea-pig 3.—On the right side of the groin (site of pseudo-tubercle inoculation) no trace of the former (pseudo-tubercle) swollen lymph glands were to be found. On the left side (site of tubercle inoculation) there was an open sore, and in connexion with it a large lymph gland partly caseous partly purulent. The spleen was enlarged and full of tubercular patches and nodules.

The liver was adherent to the diaphragm and contained a fair number of tubercular nodules and patches. Both lungs were pervaded by tubercles. Tubercle bacilli were abundant in the lymph glands and in the tubercular deposits of the viscera. No bacilli of pseudo-tuberculosis were detected in any of the viscera.

From these experiments it is, I think, justifiable to conclude that antecedent injection of attenuated bacilli of pseudo-tuberculosis produced a decided effect in retarding induced tuberculosis. Injection of experimental animals in which the process of pseudo-tuberculosis of the inguinal lymph glands was still present, with tubercular virus, though it did not prevent the development of tubercles in the lymph glands and viscera, nevertheless appeared to produce tubercular disease of a decidedly slower and less extensive character than that in control guinea-pigs. At least, the different pathological conditions found in guinea-pig No. 1 and particularly in guinea-pig No. 2 (both of which were, even after 94 days, living and seemingly in good general health) when compared with the conditions found in the control guinea-pigs (which died spontaneously after 44 and 61 days respectively) can hardly be interpreted in any than the above way. In this connexion it has to be remembered, too, that all the animals, Nos. 1, 2 and 3 (as also the control guinea-pigs), were injected at the same time and with exactly the same amounts of the same tubercle emulsion.

But however this may be, it will be granted that these experiments are highly suggestive and deserve repetition. It would be interesting also to see the result of simultaneous injection of guinea-pigs with the virus of tubercle and the virus of pseudo-tubercle; the injections being carried out at the same moment at separate points in one set of animals, and in another set mixed injection being introduced at one and the same point. Various other questions, notably the difference between simultaneous injection with attenuated and unattenuated viruses, seem to call for further experiments.

No. 2

FURTHER REPORT on the BACTERIOLOGY of SCARLATINA, with SPECIAL REFERENCE to the INVESTIGATION of TEN FATAL EXAMPLES of that DISEASE; by Dr. M. H. GORDON.

In last year's report on the bacteriology of scarlatina a description was given of some of the chief varieties of the streptococcus group. These were differentiated mainly by their morphological and cultural characters. Four types were recognised—longus, medius, brevis, and scarlatinæ or conglomeratus. While the last was my special study, investigation of the other types was necessary in order to prevent confusion, particularly as examples of all four may be met with in cultures from the tonsils of persons suffering from scarlatina. It appeared, moreover, that further details of the biological characteristics of streptococcus scarlatinæ itself could best be discerned, and their relative differential value most justly estimated, by comparing with it at some length as many other streptococci as possible.

The throats of scarlatina patients have been shown in the last two reports to harbour streptococcus scarlatinæ from an early stage of the disease up to, in several cases, a period considerably remote from the date of attack. The fact of this persistence calls to mind the same enduring quality of the Klebs-Loeffler bacillus in the throats of certain cases of diphtheria. Nor is this the only point of resemblance between these two microbes, as will be shown in the course of the present report.

During the past year I have extended my observations in three directions, viz.:—

I. The further study of the characters of streptococcus scarlatinæ as obtained from the scarlatinal tonsil.

II. A bacteriological examination of the blood and tissues in ten fatal cases of scarlatina.

III. The further observation of the characters of streptococci present in cultures from throats both normal, and inflamed but non-scarlatinal; also of streptococci from cases of suppuration and sepsis and from various general sources.

Before proceeding to describe the results obtained, however, I will give a brief outline of my present method for the isolation and observation of members of the streptococcus group. In the case of cultures from throats, experience has proved the following procedure to give more reliable results than the older "swab" method. A good sized platinum loop is sterilised and applied to the surface of the tonsil, and a drop of mucous secretion thereby removed. The contents of the loop are then distributed in a test-tube containing 1–2 cc. of sterile salt-solution. The test-tube is conveyed to the laboratory, and one or more agar plates having been prepared and allowed to set, a drop of the dilution of the tonsillar secretion is spread out over the surface of each plate by means of a bent platinum spatula, an instrument introduced in this connection by Dr. Klein. The agar plates are then incubated at 37° C. By this means a good crop of nicely separated colonies is to be obtained. The smaller colonies are almost all streptococci, and some of those most nearly resembling the colonies of streptococcus scarlatinæ are subcultured and their morphological, cultural, and in some cases physiological characters determined. I have always hitherto used agar in preference to blood-serum as a medium for the isolation of streptococcus scarlatinæ. Except where expressly stated otherwise therefore serum cultures have been avoided.

The following is a sketch of some of the chief cultural and morphological points to be noticed in the examination of a streptococcus:—

(1.) *Fluid Media.*—

- Broth, and agar condensation fluid.
  - Macroscopic
    - Fluid (clear or turbid).
    - Growth (distribution and appearance).
    - Coherency. (The effect of shaking the tube, and the readiness with which a piece of the growth admits of separation.)
  - Microscopic
    - Arrangement (low power).
    - Chains (profusion, length, curling).
    - Groups (extent and coherency).
    - Shape and size of elements (especially the presence of spindles or rods).

Litmus milk.—Acidity extent, clotting.

(2.) *Solid Media.*—In the case of solid media (agar 37° C., gelatine 20° C.), besides noting the character of the growth and colonies, the amount of chain formation, nodulation, &c., I venture to lay the greatest stress on the importance of making *impression-preparations*. I have found this one of the best means of observing an important characteristic of streptococcus scarlatinæ, otherwise very easily overlooked in many cases, namely, the formation of spindle and rod shaped elements. In the case of the agar colonies, it is my rule to examine them by this method after one day's incubation, but the gelatine colonies are often examined in a late as well as in an early stage. Thus the latter are sometimes examined by the impression-preparation method on the 10th as well as on the 3rd day.

Staining.—I have found Gram's method by far the most satisfactory; washing in water in between the solutions. By this means time is economised, and better preparations obtained, especially in the case of film specimens of the growth in the condensation fluid of an agar culture. Loeffler's blue is also at times useful, and excepting Gram the most satisfactory stain.

SECTION I.

FURTHER MORPHOLOGICAL and CULTURAL CHARACTERS of STREPTOCOCCUS SCARLATINÆ or CONGLOMERATUS of the SCARLATINAL THROAT or NARES.

The extraordinary coherency and conglomerating tendency shown by a pure culture of streptococcus scarlatinæ or conglomeratus isolated from scarlatinal throats and nares was described in last year's report. So marked may this character be in broth, or in agar condensation fluid, that in order to get a film of the growth thin and separated enough for microscopical examination it is at times necessary to crush a bit of it between two cover-glasses. Moreover, in these cases grouping is a feature of such prominence microscopically that, judging from this alone, it would be more correct to call the micro-organism a staphylo- than a strepto-coccus. The growth on the surface of agar, however, and its other characters, show that streptococcus scarlatinæ has more in common with the streptococci than with the staphylococci. At the same time conglomeration is of great use in the diagnosis of streptococcus scarlatinæ; for the property that tends to the confusion of this micro-organism with a staphylococcus completely distinguishes it from other streptococci.

Further experience, while it has multiplied this observation, has failed as yet to show me any other pathogenic streptococcus at all rivalling streptococcus scarlatinæ in the extent to which this property of coherent conglomeration may be developed. The character, however, is not displayed to such an extreme degree in all cases of streptococcus scarlatinæ obtained from the scarlatinal tonsil or nares. Varieties are met with in which, though conglomeration is a prominent feature, chains are more plentiful, and may even attain to considerable length. In these cases it is not necessary to crush the growth in the above manner in order to get it spread out enough for microscopical purposes. Another character which further experience has shown to be subject to variation is the ability to clot milk. In a number of instances now of streptococcus scarlatinæ derived from the scarlatinal throat I have failed to obtain the clotting of milk. At the same time it must be borne in mind that the same organism may at one time clot milk and at another may occasionally fail to do so. My present conclusion therefore on the value of this test is as follows :—When present, the clotting of milk may be of considerable diagnostic value, especially in some cases to be referred to later, but when no clot is obtained the organism may be streptococcus scarlatinæ all the same.

Continued observation of streptococcus scarlatinæ, however, has enabled me to recognise a character that considerably increases the distinction of this organism from others of allied type, such as the streptococcus medius or pyogenes. In last year's report it was stated that a feature of various streptococci, which had not previously received the attention it deserved, was the tendency that several of them showed to form here and there an element which might be described more correctly as a bacillus than as a coccus. It was also noted that these shapes were at times apt to resemble forms of the diphtheria bacillus. This character appeared to be of such importance that I began, soon after completing last year's report, to study more minutely its extent in various streptococci. As a result, although bacillary forms are occasionally developed by a considerable number of streptococci, especially by S. longus of the normal throat, I have found that they occur so extensively in pure cultures of streptococcus scarlatinæ as to become characteristic. Indeed, the extent to which bacillary elements can be developed is a feature that, combined with the other properties previously described, tends to completely distinguish streptococcus scarlatinæ from all other micro-organisms at present known. It becomes necessary, therefore, to describe at some length the best means of observing this pleomorphic characteristic.

On inspecting microscopical preparations made from pure cultures of streptococcus scarlatinæ, a careful search reveals here and there considerable irregularity in the size of the elements. This is a good deal more marked in some cases than in others. Observing next the shapes of the elements it is found that considerable variation exists here also. It is under these two headings that the facts which I will now describe more fully come. They are briefly these. In the first place, as regards irregularity of size. Side by side with elements of the average size others considerably above or below the mean are met with. Such irregularity appears to be a good deal more frequent in cultures of streptococcus scarlatinæ than in those of other streptococci. It is, however, chiefly in regard to variation of shape that S. scarlatinæ obtains distinction. While the majority or, at any rate, a large number of the elements of S. scarlatinæ are spheres or ovals, and from their tendency to grow in chains are identical with streptococcus, at the same time careful search reveals the presence of shapes, particularly in impression-preparations of the agar and gelatine colonies, in which the longitudinal diameter considerably exceeds the transverse. The ends of these forms are as a rule rounded or pointed, and they present every transition in shape from a coccus to a bacillus. Some are bullet-shaped, others wedge-shaped, pear-shapes and dumb-bells are occasionally present, spindles and segmented spindles are common, and here and there unmistakeable rods are formed. The latter tend to grow at places as diplo-bacilli and are frequently seen to lie in lateral apposition. They are often curved, and may even attain occasionally to considerable length. The explanation of the curving is that they represent a part of a streptococcus chain (the sinuosity of which they exactly preserve), in which, however, the coccus shape is replaced by a bacillary one, owing to the dividing capacity of the micro-organism having been locally delayed. Similarly the arrangement of the rods in parallels is explained by the fact that the streptococcus chains are frequently arranged in a similar manner.

So strong is the likeness between some of these shapes and those seen in cultures of the diphtheria bacillus that places where pointed bacilli and spindles are much in evidence suggest the possibility of the growth being a mixture of a streptococcus and that micro-organism. Such a contingency, however, has been kept well in view throughout and excluded by taking every care to subculture in the first instance always, and on all subsequent occasions whenever possible, from a single colony. Moreover, when a subculture from a single colony is made in the case of an example of streptococcus scarlatinæ that has already shown bacillus-formation, I have found that the same shapes are again exhibited under the same conditions as previously. Recently, also, in revising the whole subject previous to making this report, 10 examples of streptococcus scarlatinæ from various sources were plated, and from a single colony of each another plate culture was made. From a single colony of this I made a second plate culture, and from a single colony of the latter a subculture was made and tried in all the morphological and cultural tests that had been applied to its predecessor three generations back. In this way a triple safeguard of purity was established, with the result that in each case I obtained a repetition of the bacillus-formation under the same conditions as before, and also found that the culture behaved the same in other ways as its predecessor had done. Again, a search through my preparations made in connection with previous stages of this research has proved successful in demonstrating the presence of similar bacillary forms in impression-preparations of streptococcus scarlatinæ. Finally, in order that there should be no doubt at all, I have also recently made cultures from two more scarlatinal throats and confirmed the presence of bacillary forms in subcultures from single colonies of streptococcus scarlatinæ so obtained. But I hope to show in the following pages that this bacillus-formation is exhibited so often and in so many ways and degrees that it is a fundamental character of the micro-organism which has been alluded to under the name of streptococcus scarlatinæ or conglomeratus.

The medium in which bacillus-formation is best seen varies somewhat in different specimens of streptococcus scarlatinæ. Impression-preparations of the agar colonies after one night's incubation at 37° C. show it well in many instances. In several cases, however, it is best seen in impression preparations of the gelatine colonies at about the 10th day. In other cases it is seen already developed in the gelatine colonies by the 3rd day. On the other hand, the growth in broth and in agar condensation fluid does not show bacillus formation so well in most cases of streptococcus scarlatinæ obtained from the scarlatinal tonsil, partly perhaps owing to coherent conglomeration being so strongly developed in these media. When, however, this organism is obtained from the tissues of a mouse that has succumbed to inoculation with the tonsil specimen, and also in the case of streptococcus scarlatinæ derived from the blood and organs of a scarlatinal cadaver, the agar condensation fluid in particular is an excellent medium for the observation of bacillary forms, as will be seen later.

It must be remembered that in some cases of streptococcus scarlatinæ obtained from the scarlatinal tonsil, bacillus-formation is a character that is observed only after considerable scrutiny. It occurs side by side with and even in the same chain as typical streptococcus forms, and the latter, from their prevalence in the majority of places, may tend to mask this most important characteristic unless a special search is made. In other cases, however, bacillus formation is so strongly developed as to suggest the possibility of streptococcus scarlatinæ being mistaken for the diphtheria bacillus or its allies, unless a thorough examination of all the characters of this micro-organism is made.

Varieties of Streptococcus Scarlatinæ.—At least two sizes are met with, viz., a small and a large type. In the former conglomeration is best seen, and in the latter chain-formation. I have provisionally called the former "type A" and the latter "type B." Both types may be obtained from the scarlatinal throat at the same time; and from a mouse inoculated with type A type B may be recovered. This variation in the average size of strains of streptococcus scarlatinæ is another point in which it resembles the diphtheria bacillus. Variability in the intensity of the conglomeration displayed has been already referred to, as also has variability in the power of clotting milk. In all cases I have found that the acid-production is continuous and well marked. Alkali-production I have not observed at all in any case of streptococcus scarlatinæ, even during a month's incubation in litmus-milk. This continuity in the production of acid, and the absence of alkali-formation at any stage, are important points in relation to the differential diagnosis of some varieties of streptococcus scarlatinæ from pseudo- or true diphtheria bacilli. Lastly, the fluid of a broth culture may be rendered turbid in some cases of streptococcus scarlatinæ from the scarlatinal tonsil. Typically, however, it remains quite clear.

The growth on the surface of gelatine is always slow. The agar growth may also be delayed in some instances. A recent case in which this occurred is worth mentioning because, on examination of the small, nodulated, granular colonies present on the third day in a surface agar plate, made from a dilution of the secretion of a scarlatinal tonsil, so many spindles and bacillary forms were present that I thought at first that the organism was a small variety either of B. diphtheriæ or, because of the delay in its initial appearance, of B. xerosis. A subculture in broth, however, proved that I was dealing with streptococcus conglomeratus. This was confirmed by a litmus-milk subculture, which showed a strongly acid reaction, and was firmly clotted in 48 hours. The gelatine growth was also that of streptococcus scarlatinæ. Both on the latter medium, and on the surface of agar, bacillus-formation was very prominent. In the case of the agar growth this character was well developed after 17 hours' incubation. In broth, however, the coccus shape prevailed. In the condensation-fluid of a subculture on solidified blood-serum also this organism formed capital streptococcus chains which showed here and there a tendency to conglomeration. In the colonies on the surface of the blood-serum, however, bacillary forms were rather better seen, though not so well as on the surface of agar. A guinea-pig and a mouse were inoculated with a 48 hours' broth culture mixed with the growth scraped off from a surface agar subculture of the same age. The guinea-pig showed no symptoms, and was alive and well two months later. The mouse, on the other hand, showed some suppuration at the site of inoculation, and was dead on the ninth day. This result, and also the bacteriological examination that was made of the tissues of the mouse, confirmed the preliminary identification of this organism with streptococcus scarlatinæ in a most conclusive manner. The fact that this was one of my most recent cases, indeed it was one of the two "confirmatory" cases mentioned above, and that although alive to the bacillus-forming tendency of streptococcus scarlatinæ I still mistook this organism at first sight for either B. diphtheriæ or B. xerosis, has been my excuse for mentioning it at some length.

The EFFECT PRODUCED on the CHARACTERS of STREPTOCOCCUS SCARLATINÆ or CONGLOMERATUS of the SCARLATINAL THROAT by PASSING that ORGANISM through a MOUSE.

Technique.—For the purpose of injecting mice hypodermically, a 48 hours' broth culture is used, mixed with the growth scraped off a surface agar culture of the same age. The amount injected varies from ½ to 1 cc. according to the size of the mouse. In making a post-mortem examination, surface agar cultures are made from the heart's blood, spleen, kidney, and liver of the mouse as a matter of routine. Cultures are also made from the lungs or from the site of inoculation, or from other definite pathological lesions if such exist. In making cultures from an organ, the outside is seared with a hot spatula and a sterilised platinum loop is then thrust in. A piece of the interior of the organ, or some of its juice, is thus removed and spread out over the surface of one or more surface agar tubes. In some cases it is also advisable to make an agar plate from a dilution of the material. It is best to examine the mice as soon after death as possible, as putrefaction commences very soon in these animals, and once it has commenced the isolation of S. scarlatinæ in a state of purity is almost impossible. Most of the putrefactive organisms do not hold Gram's stain, but they grow so rapidly in culture as to hide any other organisms present.

Cover-glass specimens from the blood and organs of mice dead from the effects of streptococcus scarlatinæ show the diplococcus form of that organism most frequently. Short chains of three elements are seen in places and occasionally single cocci are detected. Small groups are also met with in some cases. A point which I have occasionally noticed, and which eventually may or may not turn out to be of some importance, is that at times cover-glass specimens from the organs of the mouse may be positive, and yet no growth will occur in cultures inoculated with material from these organs.

CULTURES from the TISSUES of MICE DEAD from S. SCARLATINÆ or CONGLOMERATUS of the SCARLATINAL THROAT or NARES.

In a fatal case, the agar tube-plates made from the organs of a mouse show next day a variable number of small colonies having a general appearance similar to those of the micro-organism injected. The cultures from the kidney, spleen, and liver of the animal may be more successful than those from the heart's blood. Especially is this so in cases where a considerable period has elapsed between the date of inoculation and the death of the mouse.

On subculturing these colonies in *broth* it is found that in a number of cases turbidity of that fluid is produced. In others, however, the minority according to my present experience, the broth remains clear. In either case the organism most frequently obtained is a streptococcus that, while corresponding with the organism injected in its chief morphological characters, nevertheless shows some modifications. In broth, for instance, conglomeration though partly present is much less intense than in the original, and on the other hand chain-formation is generally now much more evident. In *agar condensation-fluid* conglomeration, though less marked than in the original, is well seen, but here again chain-formation is prominent. The result of the combination of these two features, viz., conglomeration and chain-formation, may be very characteristic arrangement of the growth in agar condensation-fluid to which I have given the name of "Lace-work," because the little conglomerate strands joined to each other by chain-work form an arrangement that when magnified about 500 diameters is not unlike the pattern of a piece of lace. The growth on the surface of *agar* is seen to be more extensive than in the case of the original. The agar colonies do not show so well the characteristic markings and nodules shown by those of the original. They are also smoother, a feature explained no doubt by the diminution in the power of conglomeration. When viewed with a low power (× 70) chain work is generally evident at places. As regards the *gelatine colonies* the only difference observed is that they are apt to grow a little faster than in the case of the original. *Litmus-milk* shows a good acid reaction after some days, but no clot is as a rule produced. *Bacillus-formation.*—In broth this faculty is not generally marked, but on the other hand the streptococcus form is best seen. The growth in agar condensation fluid, however, shows the presence of bacillary forms in 48 hours, and the combination of this with the "lace-work" pattern is characteristic by the extent to which it is present. Impression-preparations of both the agar and the gelatine colonies show transitional, spindle-shaped, and bacillary forms very plainly in the majority of cases. It must not be forgotten, however, that in all these media bacillus-formation is shown by the minority of the elements. *Summary.*—The streptococcus form of streptococcus scarlatinæ or conglomeratus obtained most frequently from the bodies of mice that succumb to infection with that micro-organism shows a lessening in the conglomerative faculty accompanied by an increase in chain-formation. "Lace-work" pattern is seen in agar condensation-fluid. Bacillary forms are to be seen in agar condensation-fluid in 48 hours, and in impressions of both the agar and gelatine colonies. Litmus milk is not generally clotted.

Besides the streptococcus just described, however, there is another feature of the cultures from the mice that is of great interest. In some cases the small grey colonies that appear in the agar tube-plate from the organs of mice dead from infection with streptococcus scarlatinæ are found to consist of a form which, while corresponding with streptococcus scarlatinæ or conglomeratus in a most striking manner as regards its macroscopic and cultural characters, yet is found microscopically to consist entirely of bacillary forms. From its well-marked faculty for coherent conglomeration I propose to call this organism Bacillus conglomeratus.

Colonies of bacillus conglomeratus appear side by side with those of the streptococcus just mentioned in agar tube-plates from the organs of mice that succumb to infection with streptococcus scarlatinæ or conglomeratus obtained from the throats of scarlatinal patients. So alike are the colonies of the two forms that it is often impossible to discriminate between them by the eye, hand-lens, or lowest power of the microscope. In some cases bacillus conglomeratus alone is obtained, in others the streptococcus usually recovered from these mice, and it is possible at times to obtain both from the same organ.

In a broth subculture from a single colony of B. conglomeratus the fluid may become as turbid as in the case of the streptococcus derived in the same way from the mouse, or it may be perfectly clear as in the case of typical streptococcus scarlatinæ from the scarlatinal throat. In either case the growth occurs chiefly at the foot of the tube. On making a microscopical preparation of it, conglomeration is found to be extremely well developed. In some cases the growth in broth is as difficult to separate out into a thin layer as it is in the most intensely conglomerate type of streptococcus scarlatinæ from the scarlatinal throat, and may similarly require crushing between two cover-glasses. In such a case it is found that the appearance of the crushed-out mass in the two cases is similar, both resisting separation in the same way; but while in the former case the elements are cocci, here they are entirely bacillary. As a rule, however, such force is not needed to separate the growth, but in all cases conglomeration is found microscopically to be strongly developed.

If a microscopical preparation of a broth culture of bacillus conglomeratus is searched with a magnification of about 500 diameters, places will be found where chain-work is well marked. The arrangement and curling of the chains is similar to that of the streptococcus derived from the mouse, and is in some specimens of B. conglomeratus exceedingly remarkable. The "lace-work" pattern also may be seen in these cases. Irregularity of size is seen at places, sometimes a chain above the average size being seen, and at others one below it. The bacilli are often arranged in parallels, and diplo-bacilli are not infrequent.

Some show curving. Length varies; here and there a curling filament is seen, but the majority are of medium size. The extremities of the bacilli are round or pointed. They stain evenly, and retain Gram extremely well.

The bacilli therefore in arrangement, shape, and staining reaction are similar to those bacillary forms met with in pure cultures of streptococcus scarlatinæ or conglomeratus of the scarlatinal tonsil. Here, however, they entirely prevail. *Agar condensation-fluid.*—Conglomeration and chain-formation are both well seen. The curling of the chains in the manner of a streptococcus is sometimes better seen here than in broth. "Lace-work" arrangement may also be exhibited. *Agar colonies.*—Small grey discs indistinguishable to the eye from those of the streptococcus. The rate of growth is similar in both instances. Nodules are occasionally well seen in the colonies. Impressions show here and there curling chain-work of bacilli. *The gelatine colonies* are also similar in appearance to those of the streptococcus. The rate of growth is also similar. Nodules are occasionally seen in the older gelatine colonies. Impressions show the parallel arrangement of the bacilli well. *Litmus milk* is turned acid in a night by B. conglomeratus, and in a few days as a rule there is a clot. Clotting, however, as in the case of the streptococcus conglomeratus, is not always produced. But the acid reaction is always seen and is continuous, no alkalinity being produced at any time, even during a month's incubation. In the growth in agar condensation-fluid, and occasionally elsewhere, large spherical shapes or semi-lunar forms may be met with. Similar forms may occasionally be seen in cultures of streptococcus scarlatinæ or conglomeratus. *Summary.*—Bacillus conglomeratus, therefore, bears such a strong resemblance to streptococcus conglomeratus or scarlatinæ of the scarlatinal throat, both morphologically and culturally, that I believe them to be different phases of the same micro-organism. The bacilli that here entirely prevail are identical with those bacillary forms that are occasionally developed in pure cultures of streptococcus scarlatinæ or conglomeratus of the scarlatinal tonsil, in arrangement, shape, and staining reaction.

SOME of the CHIEF MORPHOLOGICAL and CULTURAL DIFFERENCES between B. CONGLOMERATUS, B. DIPHTHERIÆ, HÖFFMANN'S BACILLUS, and B. XEROSIS.

(1.) *Broth.*—B. conglomeratus shows more intense and coherent conglomeration than do the others. The curling chains of bacilli showing such strong similarities with streptococcus chains in contour and arrangement are unlike anything which has been described in cultures of B. diphtheriæ, Höffmann, or xerosis. (2.) The *agar colonies* of B. conglomeratus are much smaller, finer, and more transparent than those of the other bacilli. On impression also they show curling chains at places, a feature still to be observed in the case of the other organisms. (3.) On *gelatine* B. conglomeratus grows a great deal more slowly than do the others. Bacillus conglomeratus in fact, like the streptococcus conglomeratus, grows more slowly on gelatine than does the streptococcus pyogenes. Neither does B. conglomeratus form a white raised pearly growth like the other organisms do as time goes on. Finally, in *litmus milk* B. conglomeratus produces a well-marked acid reaction, and often also a clot. I have not yet seen an alkaline reaction even in a month's incubation. On the other hand, B. diphtheriæ produces at first a feebly acid reaction replaced later by an alkaline one, B. Höffmann and xerosis produce alkaline reactions, and no one of these three ever clots milk. *Summary.*—The marked conglomeration, much slighter growth on agar and gelatine, the more prominent and continuous acid production and clotting of milk are some of the grosser characters that differentiate B. conglomeratus from the above bacilli. The danger of confusing B. conglomeratus with one of the above three organisms is in fact quite excluded by a thorough examination of the characters of the organism.

FORMS INTERMEDIATE between the STREPTOCOCCUS and BACILLUS CONGLOMERATUS RECOVERED from the MICE that SUCCUMB to INOCULATION with S. SCARLATINÆ or CONGLOMERATUS of the SCARLATINAL TONSIL.

It must not be supposed that the line between the streptococcus recovered from these mice and bacillus conglomeratus is a sharp one. Several of the streptococcus forms show a development of bacillary elements that is very striking, and thus they form links between the two extremes. From the point of view of cultures from the scarlatinal cadaver it will be seen that the streptococcus is the more important of the two. The bacillus conglomeratus I regard more in the light of what botanists term a "sport." But as the latter embodies a most characteristic morphological feature of the micro-organism obtained so frequently from the scarlatinal throat, it is of great interest and of no little importance

EXPERIMENTS with the STREPTOCOCCUS and with the entirely BACILLARY FORM or BACILLUS CONGLOMERATUS obtained from MICE INFECTED with STREPTOCOCCUS SCARLATINÆ or CONGLOMERATUS.

If ½—1 cc. of a 48 hours' broth culture of the streptococcus obtained most frequently from the tissues of the above mice be mixed with the growth on a surface agar culture of the same age, and injected into mice, an increase of virulence may in some cases be demonstrated, death now ensuing in a proportion of the animals injected in 1–3 days. The streptococcus recovered from these mice is identical in morphological and cultural respects with the form inoculated.

In a recent case of a mouse that died on the tenth day after infection with S. scarlatinæ or conglomeratus obtained from the scarlatinal throat, a culture from the liver of the animal gave bacillus conglomeratus; while an enlarged axillary lymphatic gland gave the streptococcus form usually obtained in such cases. These two organisms were in fact identical with the two types described above as being obtained from mice. The bacillus from the liver of the mouse, for instance, stained well and evenly with Gram; in broth, though slight turbidity was produced, conglomeration was extremely marked microscopically; in litmus milk a strongly acid reaction was produced and a firm clot by the third day. On the other hand, the streptococcus from the enlarged axillary gland of the mouse made broth turbid and while it formed excellent chains in that medium did not show conglomeration to any extent. In agar condensation-fluid it showed "lace-work" pattern and bacillary forms in 48 hours. The latter were also seen in impressions of both the agar and the gelatine colonies of the streptococcus. In litmus milk acidity was produced, but no clot. To the eye, hand-lens, and under a power multiplying 50 diameters the colonies on agar and gelatine of the bacillus and the streptococcus were extraordinarily alike. A gelatine streak culture of each during and after a month's incubation presented exactly the same appearance to the eye. Gelatine stab-cultures showed in the depth along the line of puncture the same small drop-like colonies in both cases.

(A.) *The Bacillus.*—Two guinea-pigs were inoculated hypodermically with the bacillus, and two others with the streptococcus. One of the guinea-pigs inoculated with the bacillus was alive and well eight weeks later, having shown no symptoms; the other died on the 9th day after inoculation. Post-mortem the organs were found to be congested, the lungs in particular showing dark patches. Cover-glass specimens of the heart's blood showed no micro-organisms, but those made from the spleen, kidney, and liver showed diplococci that held Gram's stain. No bacilli were found. Cultures from the heart's blood, spleen, kidney, and lung remained sterile. An agar tube-plate from the liver, however, gave a pure culture of a streptococcus. This streptococcus was in an attenuated condition, but showed a tendency here and there to develop bacillary forms in agar condensation-fluid. I only succeeded in getting growth on agar at 37° C. and on gelatine at 20° C. The colonies in both cases resembled those of streptococcus scarlatinæ or conglomeratus. In stab-gelatine the same string of small drop-like colonies as seen in the case of S. scarlatinæ appeared in the depth, along the line of puncture. The micro-organism would not grow in milk or broth. Attenuation was so marked that the organism soon died, and I was therefore unable to investigate further.

(B.) *The Streptococcus.*—Of the two guinea-pigs inoculated with the streptococcus, one was apparently unaffected, being alive and well eight weeks later. The other, however, was dead 24 hours after injection. Post-mortem the lungs and organs were congested. Cover-glass specimens of the heart's blood showed diplococci and short chains. Pure cultures of the streptococcus were obtained from the heart's blood, kidney, spleen, and liver. This streptococcus was identical with that injected except in two respects. The fluid of the broth-culture now remains quite clear; the growth occurs as a conglomerate mass or masses at the bottom, and shows, microscopically, good chains and conglomeration. The second point in which the streptococcus is modified is in regard to its gelatine colonies, which now no longer show bacillary forms. The agar colonies, however, show bacillary forms as well as previously, and the same is true of the growth in agar condensation fluid, where also "lace-work" pattern is still seen.

It appears from the above that an example of the streptococcus most frequently obtained from the tissues of mice that succumb to injection with streptococcus scarlatinæ or conglomeratus of the scarlatinal throat, after further passage through a guinea-pig, leaves broth clear and shows good conglomeration there. Lace-work and bacillary forms are seen in agar condensation-fluid. While the agar colonies still show bacillary forms, the latter are not now seen in the gelatine colonies. Litmus milk, as prior to the passage of the organism through a guinea-pig, is not clotted, but shows an acid reaction.

These then are the cultural and morphological characters of an example of streptococcus scarlatinæ or conglomeratus obtained in the first place from the throat of an uncomplicated case of scarlatina, and passed first through a mouse and then through a guinea-pig. It will be seen further on that they are also the characters of the streptococcus most frequently obtained from the tissues of persons who succumb to scarlatina.

ANALYSIS of SEVEN EXAMPLES of STREPTOCOCCUS SCARLATINÆ

No.	Origin.	Scarlatina Case.	1 Day Broth.	2 Days Agar Fluid.	1 Day Agar Cols.
52	Throat	Typical scarlatina following operation for adenoids. 3rd day since attack began. No complications.	Conglomeration excellent. Coccus forms entirely.	Conglomeration excellent. Coccus forms prevail. A few bacillary.	Some bacillary, majority coccus.
54	Throat	Typical scarlatina. 8th day since attack began. No complications.	Conglomeration chains and bacillary forms good, but majority coccus.	Conglomeration and chains good. Few bacillary. Majority coccus.	Bacillary forms seen at places
51	Throat	Typical scarlatina. 19th day since attack began. No complications.	Conglomeration and chains good. A few slightly bacillary. Majority coccus.	As broth	Several bacillary forms seen.
35	Throat	Typical scarlatina. 5th week since attack began. No complications.	Conglomeration excellent coccus entirely.	As broth	Majority coccus, but bacillary forms good.
55	Throat	Typical scarlatina. 5th week since attack began. No complications.	Conglomeration and chains good. Coccus entirely.	Conglomeration good. Chains fair. Bacillary forms good, but coccus majority.	Practically entirely bacillary.
20	Throat	Typical scarlatina. 5th week since attack began. No complications. Just going out.	Conglomeration and chains good. Coccus entirely.	Not observed	Some show bacillary forms.
15	Nares	Typical scarlatina. 9th week since attack began. 7th day of nasal discharge. Adenitis.	Conglomeration fair, chains good. Coccus entirely.	Not observed	Excellent bacillary forms at places.

with SPECIAL REGARD to BACILLUS-FORMATION.

Gel. Cols.	Litmus Milk.	Mouse.	Organs, etc. of mouse examined.	Result.	Litmus Milk.
5th day some bacillary, majority coccus.	Strong acid, firm clot 2 days.	Died 8th day after inoculation.	Spleen	B. conglom. ..	Strong acid. Clots.
3rd day some spindles and bacillary forms seen. 10th day ditto.	Acid. No clot	Suppuration site of inoculation. Killed 52nd day.	Liver	B. conglom. ..	Strong acid. Clots.
			Pus site of inoculation.	Streptococcus	Acid. No clot.
Not observed	Acid. No clot	Died 7th day..	Liver	B. conglom. ..	Strong acid. Clots.
			Axillary lymph gland.	Streptococcus	Acid. No clot.
7th day a few bacillary forms.	Strong acid, firm clot 3rd day.	Died 31st day	Liver	B. conglom. ..	Strong acid. Clots.
			Kidney ..	1. B. conglom.	Strong acid. Clots.
			„ ..	2. (Intermediate)	(Not tested).
			„ ..	3. Streptococcus	Acid. No clot.
3rd day almost entirely spindles and baccilli.	Strong acid, firm clot 3rd day.	Suppuration site of inoculation. Died 9th day.	Liver	B. conglom. ..	Acid. No clot.
			„	Streptococcus	Acid. No clot.
			Pus site of inoculation.	Streptococcus	Strong acid. Clots.
3rd day excellent bacillary forms.	Acid. No clot	Died 10th day	Heart's blood	Streptococcus	Acid. No clot.
10th day a few slightly bacillary, great majority coccus.	Acid. No clot	Died 7th day ..	Heart's blood	Streptococcus	Acid. No clot.
			Liver	„	„
			Spleen	„	„
			Kidney ..	„	„

SECTION II.

THE BACTERIOLOGY OF THE SCARLATINAL TISSUES.

Before proceeding to describe my results in this section, it is convenient to introduce here a short summary of Kurth's original paper on the occurrence of streptococcus conglomeratus in scarlet fever. This paper was published in the *Arbeiten aus dem Kaiserlichen gesundheitsamte. Band VII.*, 1891, and the results cited may be condensed as follows :—

I. Scarlet Fever.—Twelve cases in all of scarlet fever were bacteriologically examined, with the result that streptococcus conglomeratus was found in four. Out of seven cases in which (*a*) *the tonsil* was examined, he failed to isolate conglomeratus in six, but in the seventh case this organism was obtained. In each of the six negative cases streptococci other than conglomeratus were present. (*b*) *Elsewhere than the tonsil* during life—In a case that developed a cervical abscess streptococcus conglomeratus was obtained on two occasions from the pus of this abscess. On the single occasion when Kurth examined an aural discharge, he failed to obtain any streptococcus. (*c*) *Autopsies*—In two out of six autopsies he obtained streptococcus conglomeratus. In case I. he got this organism from an abscess in the region of the right vocal cord, from the kidney, and from the spleen. Sections of the spleen also showed small conglomerate masses of this organism in situ. In case IV. again the spleen showed streptococcus conglomeratus both in culture and in situ. In the remaining four autopsies however streptococcus conglomeratus was not identified, but the spleen in each instance yielded a streptococcus which differed from that organism. In two cases the kidney was also examined. No growth was obtained in one ; in the other a streptococcus differing from conglomeratus was obtained. In one abscess of the neck also he found a streptococcus which differed from conglomeratus ; and from one liver a similar organism was obtained. In short, Kurth examined the spleen in every one of his autopsies, and in two instances out of six he obtained conglomeratus. On three occasions he examined pus obtained from the region of the throat or neck and found conglomeratus twice. Kurth therefore on the whole obtained from scarlet fever cases streptococci that he could not identify with conglomeratus more frequently than he obtained that organism. In isolating conglomeratus, his method was to sterilise the outside of the organ, and then to cut out a small piece from the interior. This small piece of the organ was sliced up, and either sown in broth or mixed with melted agar and a plate prepared. Kurth practically limits his description of the cultural morphology of conglomeratus to its growth in broth. He lays great emphasis on its conglomerating tendency in that medium. No description is given of the microscopical appearance of its growth in other media, nor is its behaviour towards milk described. He inoculated white mice from a loopful of the conglomerate growth in broth, with a fatal result in by far the majority of cases. The interval between the date of inoculation and the death of the mouse was either a few days, or it was a matter of weeks, and sometimes even of months. In both the latter cases local suppuration was produced.

II. Controls.—Kurth's investigation was not limited to an examination of the streptococci occurring in scarlet fever, but he also examined many streptococci from other sources. They were as follows:—Streptococcus erysipelatos, two specimens, and streptococci from the following eight sources—Pus, 1, blister fluid, 1, pemphigus, 1, gangrene, 1, septicæmia, 1, tonsillitis, 1, influenza, 2. Finally he examined the streptococci obtained from the organs in five diptheria autopsies. In all instances save one he found the above streptococci to be quite different from streptococcus conglomeratus in broth culture. In the exceptional instance however, the streptococcus came from the tonsil of a case of ordinary tonsillitis, and it showed some conglomeration in broth. He was unable to come to a definite conclusion with regard to this streptococcus, as it had been met with before he was acquainted with streptococcus conglomeratus of scarlet fever.

Application of Kurth's results.—Kurth deserves credit for recognising the exceptional conglomerating tendency of this streptococcus that occurs in scarlet fever. From his description and photographs, and from its virulence for mice, I have no doubt that the "streptococcus conglomeratus" of Kurth is identical with the streptococcus which I have obtained most frequently from the scarlatinal cadaver and deal with below. This form, though the conglomeration that it displays is conspicuous, does not rival the streptococcus which I have above described as obtained so frequently from the scarlatinal tonsil in the mild type of the disease, in capability for coherent conglomeration.

The term Streptococcus Conglomeratus.—In this report I have primarily restricted the term streptococcus scarlatinæ or conglomeratus to the streptococcus obtained from the scarlatinal tonsil in the mild type of the disease. This restriction is desirable because in *all ways* that organism is the most distinct from streptococcus pyogenes. The above "streptococcus conglomeratus" of Kurth, as also the streptococcus which I am about to describe as obtained most frequently from the scarlatinal cadaver, is so closely approached by exceptional examples of streptococcus pyogenes, that it is only by means of certain special characters that their distinction from the latter organism and their identification with S. scarlatinæ is in some cases satisfactorily achieved. My restriction of the term "conglomeratus" to a type that Kurth probably did not know, is open to criticism, but it is absolutely necessary unless the term conglomeratus is to be dropped; and this term so aptly describes one of the most striking characteristics of streptococcus scarlatinæ that it seems a pity to lose it. At the same time, several investigators have hastily applied the term conglomeratus to obvious examples of streptococcus pyogenes, so that Dr. Klein's original term streptococcus scarlatinæ is perhaps the better one.

APP. B, No. 2.

On the Bacteriology of Scarlatina; by Dr. Gordon.

BACTERIOLOGICAL EXAMINATION of a COMPLICATION OCCURRING DURING the COURSE of SCARLATINA.

I am indebted to Dr. Hopwood for the following notes of this case, and to Dr. Sidney Phillips for permission to publish them. M. T., female, 30, moderate attack of scarlet fever; slight "rheumattism" (without effusion) on 5th day, disappearing on 10th; temperature then normal. Rheumatism again on the 15th. Temperature, which had been irregular for a day or two, began to rise and continued above normal (104·4° in one instance) whether there was or was not rheumatic pain felt. Secondary sore throat; yellowish patch on one tonsil 18th day. No Klebs-Loeffler bacillus in culture from throat. Pneumonia 21st day. Fluid in pleura 25th day. Serum tube inoculated from some of it drawn off 26th day gives a pure culture of streptococcus.

Dr. Hopwood very kindly gave me this culture. The characters of the streptococcus are as follows:—

Broth 1 *day* 37° *C.*—The fluid remains quite clear. At the bottom of the tube is a white coherent mass of growth. While this does not require crushing between two cover-glasses to get it spread out enough for microscopical purposes, it resists separation to a considerable extent. Microscopically conglomeration is conspicuous, but long chains are also present and very striking. In the course of 48 hours distinct bacillary forms are present in a minority. They have pointed ends and occur in some places in the same chain as coccus-shaped elements arranged in typical streptococcus formation.

Agar condensation fluid 37° *C.* 2 *days.*—Conglomate flocculi are visible here in 48 hours. Microscopically some conglomeration is seen, and chains are plentiful and long. Thus "lace-work" pattern is seen. Microscopically spindle forms and capital bacillary forms are seen amidst a majority of cocci and intermediate forms.

The agar colonies at 37° *C.* have a grey and granular appearance. The majority have a firm edge, but some show a frilling of chain-work. Microscopically spindle and bacillary forms are present, though in a minority.

Gelatine colonies 20° *C.*—The growth on gelatine is very similar to that of the streptococcus form of S. scarlatinæ recovered from mice. Impression preparations of the gelatine colonies made soon after the streptococcus had been obtained from the pleural effusion showed no definite bacillary forms. The organism, however, has been cultivated for now a year outside the body, with the result that spindle-shaped forms and bacillary forms are at the present time well seen in impressions of the gelatine colonies on the 3rd day.

Litmus milk 37° *C.*—An acid reaction is produced, but no clot.

Pathogenicity.—A mouse inoculated with this streptococcus soon after it had been recovered from the pleural effusion

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showed some suppuration at the point of inoculation and died on the tenth day. The streptococcus was recovered from its blood and organs.

Comments—This streptococcus recovered in pure culture from the pleural effusion was, when first obtained, identical with the streptococcus most frequently recovered from the scarlatinal cadaver, as will be seen later. Owing to my present experience of the streptococcus pyogenes, however, I hesitated at first to absolutely identify this streptococcus of the pleural effusion with streptococcus scarlatinæ, although the points of resemblance were very striking. But now that the gelatine colonies show the spindles and bacillary forms that are so characteristic of streptococcus scarlatinæ or conglomeratus, I am able to definitely identify this streptococcus of the pleural effusion with streptococcus scarlatinæ or conglomeratus obtained so often from the scarlatinal throat in uncomplicated cases of scarlatina.

BACTERIOLOGICAL EXAMINATION of TEN SCARLATINAL CADAVERS.

Technique.—Strictly aseptic conditions were observed in making cultures from the blood and organs. In the case of the heart, the pericardium was seared with a hot iron, opened with a sterile instrument, and then with a sterilised pair of scissors a window was cut in the wall of the right ventricle. Some of the contained blood was then drawn up in a sterilised capillary pipette, and at once introduced into culture tubes. In some cases, where it was desirable to examine a larger quantity of blood, a specially made, sterilised hypodermic syringe was also filled with the blood in the ventricle. In this way it was possible to get $\frac{1}{10}$—1 cc. of the heart's blood. In making cultures from the organs, the following procedure was adopted :—The outside of the organ was seared with a hot iron for an area of 1 square inch. A cut was then made in the centre of this area with sterilised scissors. A good sized platinum loop was then thrust in, and some of the pulp and juice of the organ removed and sown in culture-tubes. In making cultures from an enlarged cervical gland one of those nearest the tonsil was dissected out, seared on the outside with a hot iron, opened with a sterilised instrument, and cultures made as above.

Broth and agar cultures were, as a rule, made from each source. Both a gelatine and a blood serum culture were also made from dilutions of the heart's bloods. Agar plates were made from all the heart's bloods and spleens. In cases 3, 5, 7, and 8 broth and agar cultures of the heart's blood were placed under anaerobic conditions, and incubated at 37° C. Finally, in cases 3, 5, 8, and 9 some of the actual heart's blood of the scarlatinal cadaver was inoculated directly into mice.

For the clinical notes of the following cases, and for permission to examine these fatal cases of scarlatina, I am indebted to the following Medical Superintendents of Metropolitan Asylums Board Hospitals :—Doctors Caiger, Cuff, Goodall, Gayton, and

Turner. I take this opportunity of thanking these gentlemen and members of their staff for the courteous assistance which they have given me.

CASE I.—B.K. Male, 4. "Scarlet fever."

Previous history.—Measles. "Fits."

May 18th.—Vomiting, sore throat, rash, headache.

May 19th.—Admitted. Scarlet punctate rash on trunk. Tongue furred. Fauces injected. Exudation on tonsils. Cervical glands slightly enlarged.

May 20th.—Temperature above 102°. No fit since yesterday. Rash fading. Much mucus on fauces.

May 21st.—Rash still out. Pulse very feeble. Temperature 104°. Patient died of cardiac failure.

Autopsy, May 23rd.—Both tonsils swollen. Small points of pus in the follicles, in some places running together. Cervical glands swollen and soft. Other organs normal to naked eye. Pericardial fluid is increased as in all the subsequent cases.

Micro-organisms demonstrated in situ.—Cover-glass specimens of the heart's blood show numerous short chains and groups of streptococcus. No other organisms than these were seen in a thorough search through four preparations. Sections of the kidney and spleen did not reveal any organisms.

Cultures.—All cultures made from the heart's blood gave streptococcus in pure culture. The spleen and kidney also gave pure cultures of the same. No growth was obtained from the liver. From an enlarged cervical gland near the tonsil two out of three cultures had the streptococcus in pure culture. In the third culture this organism was in an overwhelming majority, but one colony of staphylococcus albus liquescens was also present.

Summary.—The streptococcus was obtained in pure culture from the heart's blood, spleen, kidney, and in an overwhelming majority from the cervical gland.

Morphological and cultural characters of the streptococcus.—From all four sources the streptococcus has the same characters. The broth remains clear, conglomeration is conspicuous, and chains are also well marked. Lace-work and bacillary forms are seen in agar condensation fluid in 48 hours. Bacillary forms were seen in impressions of the agar colonies after one night's growth. In impression-preparations of the gelatine colonies, no definite bacillary forms were seen when this organism was recently obtained from the scarlatinal tissues. At the present time, however, after a year's cultivation outside the body, these forms have begun to show in the gelatine colonies. In litmus milk acid is produced, but no clot..

Pathogenicity.—A mouse inoculated with a culture of the streptococcus from the heart's blood of this case showed some formation of pus at the site of inoculation, and died on the 17th day. The streptococcus was recovered.

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Comments.—The streptococcus obtained from this remarkably pure case of scarlatina is the same as that obtained from the pleural effusion in the preceding case. Both acquire on culture that characteristic property of bacillus formation in their gelatine colonies which, taken with their other characters, enables them to be eventually definitely identified with streptococcus scarlatinæ or conglomeratus.

Case II.—B. S., male, 2½. "Scarlet fever."

October 15th.—Vomiting. Sore throat.

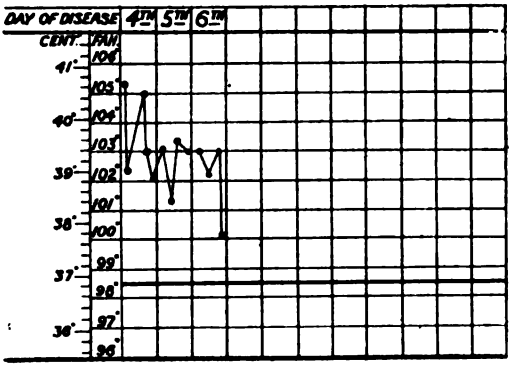
October 17th.—General rash.

October 18th.—Admitted. Punctate erythema on chest, back, arms, and legs. Tongue peeled. Tonsils and fauces inflamed. A large quantity of mucus.

October 19th.—Rhonchi at both bases. Note there impaired. Rapid respiration. Cervical adenitis. Throat culture, no diphtheria bacilli found, only streptococci.

October 20th, 9 p.m.—Death.

Temperature Chart.



Autopsy, October 22nd.—Punctate erythema still clearly visible on chest and limbs. Tonsils show points of pus in the follicles. Cervical glands enlarged. Lungs show patches of broncho-pneumonia. Other organs, including brain, congested.

Micro-organisms demonstrated in situ.—Cover-glass specimens of the heart's blood show no micro-organisms, sections also of the spleen, kidney, liver, and lung reveal none. Patches of broncho-pneumonia were seen in sections of the lung. Sections of the enlarged cervical gland, however, were very successful, conglomerate masses of streptococcus being demonstrated towards the outer edge of the gland.

Cultures.—Several droplets of heart's blood from the capillary pipette gave no growth. I therefore emptied the hypodermic syringe, which had been filled with the heart's blood, into a large broth tube. The result was that a pure culture of streptococcus was now obtained. Cultures from the spleen and kidney gave no growth. An agar culture from the liver, however, gave a pure culture of streptococcus. A culture from a broncho-pneumonic patch gave the streptococcus and B. coli. Both cultures from the enlarged cervical gland, of which sections made later gave so successful a result, yielded pure cultures of the streptococcus.

Double cultures were made in this case from the heart's blood, kidney, liver, and cervical gland. In the latter case alone both tubes gave growth. The cervical gland therefore contained the streptococcus in larger quantity than the other sources. This conclusion was confirmed by sections. It supports the contention mentioned elsewhere as to the route of infection, a route that though generally suspected has, so far as I am aware, not been previously actually demonstrated.

Summary.—Streptococcus was obtained from the heart's blood (pure), liver (pure), cervical gland (pure), lung (mixed). The spleen and kidney, however, gave no growth of any kind.

Morphological and cultural characters of the streptococcus.—The streptococcus obtained from this case was identical in morphological respects with that obtained from the preceding case. The streptococcus from the cervical gland in this case, however, clots milk, but the rest do not. Chain-formation was particularly good in the agar condensation fluid. The gelatine colonies do not yet show definite bacillary forms.

Pathogenicity.—A mouse inoculated with the streptococcus from the cervical gland died on the 21st day and the organism was recovered. No local suppuration was present.

Comments.—The streptococcus obtained in this case was apparently identical with that obtained in the two preceding cases, viz., the pleural effusion and case I. But whereas the latter have now developed definite "bacillus-formation" in their gelatine colonies, this feature cannot yet be said to have definitely commenced in this case. I cannot therefore at present claim that the streptococcus in this case is streptococcus scarlatinæ, although there is every probability that such is the case.

Case III.—E. S., female, 3½. "Scarlet fever."

October 22nd.—Vomiting. Rash on chest and limbs.

October 23rd.—Headache. Sore throat. Swollen glands of neck.

October 24th.—Admitted to hospital. Punctate erythema and finely vesicular rash on chest, back, and limbs. Tongue coated. Tonsils and fauces swollen and inflamed, and mucus secretion copious.

October 25th.—Throat more offensive and dirty. Child restless, tossing about.

October 26th.—Profuse rhinorrhœa.

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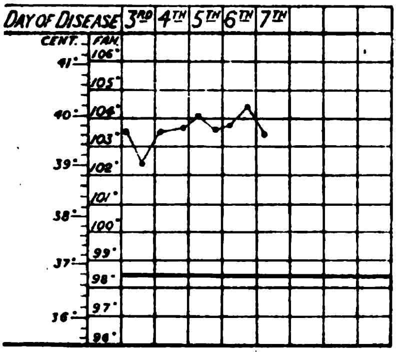
October 27th.—Very rapid pulse (200); takes food badly, Throat very dirty. Right cervical gland rapidly increasing, tender, and hard. Râles over left base.

October 28th.—Died suddenly.

Note.—Urine on 25th and 26th free from albumen.

TEMPERATURE CHART.



Autopsy, October 29th.—Tonsils ulcerated. Neck swollen. Cervical glands enlarged. Organs congested. Lungs show a few patches of broncho-pneumonia, but by far the greater part of these organs appears to be normal.

Micro-organisms demonstrated in situ.—Cover-glass specimens of the heart's blood show masses of streptococcus. The latter organism is literally swarming in the heart's blood of this case, and is present in larger numbers than in the heart's blood of any of the other cases examined. Sections were made in this case of the liver, kidney, spleen, cervical gland, and tonsil. No organisms were demonstrated in the spleen and liver. Sections of the kidney, however, showed small masses of streptococcus in several of the blood vessels of that organ. Sections of the cervical gland showed the same organism completely plugging one small blood vessel and partially occluding another. Sections of the tonsil showed the streptococcus invading the lymphoid tissue of that organ and making its way inwards apparently by lymphatic paths. The blood vessels of the tonsil appeared remarkably free of organisms.

Cultures.—The heart's blood, spleen, kidney, and cervical gland gave pure cultures of streptococcus. The liver gave a majority of the same organism, and a few colonies of B. coli. An agar plate made from the secretion lying on the surface of the tonsil showed the same streptococcus, together with streptococcus brevis.

Summary.—The streptococcus was obtained from the tonsil (mixed), cervical gland (pure), heart's blood (pure), spleen (pure), kidney (pure), and liver (mixed).

Morphological and cultural characters of the streptococcus.—The streptococcus obtained from the above sources in this case was identical in morphological respects with that obtained in case II. While therefore it is highly probable that the organism is streptococcus scarlatinæ, I cannot absolutely identify it with that microbe. The only streptococcus, out of the six obtained in this case, that clots milk is that obtained from the spleen.

Pathogenicity.—¼ cc. of the actual heart's blood of this case was injected into a mouse. The animal was dead on the 4th day. No local suppuration had occurred, but the animals heart's blood was swarming with the same streptococcus as was the blood injected. Another mouse injected with the streptococcus from the tonsil showed local suppuration, and died on the 18th day. Putrefaction prevented recovery of the streptococcus.

Comments.—The masses of streptococcus present in the heart's blood of this case were very remarkable—unfortunately all cultures of this organism are now dead, so that it cannot be examined to see if the faculty of "bacillus-formation" in its gelatine colonies has been acquired. It must therefore remain as one of the cases in which it is not safe to say more than that the streptococcus that caused the fatal issue of the disease was probably streptococcus scarlatinæ.

Case IV.—C.G., male, 2½. "Scarlet fever, nephritis." Admitted August 12th, 1899. Sent to hospital as a case of diphtheria. Hospital notes as follows:—

August 8th.—Headache, vomiting, diarrhœa.

August 9th.—Sore throat, swollen glands, nasal discharge.

August 12th.—On admission, tonsils swollen, patches of loose exudation on both sides. Nasal discharge. Temperature 100°. Diphtheria anti-toxin given.

August 13th.—Cultivation from throat showed staphylococci; no diphtheria bacillus; urine contains blood and two-thirds albumen; tonsils ulcerated.

August 16th.—Death.

Note.—The urine could not be measured, about 2–3 ounces passed daily.

Autopsy.—August 18th.

Demonstration of organisms in situ.—Cover-glass specimens made from the kidney of this case showed a few diplococci. It was unfortunately not possible to examine the other organs.

Cultures.—Cultures were made from the kidney and from a little blood obtained from a small vessel in a piece of adipose tissue adherent to the kidney. The culture from the kidney direct gave streptococcus scarlatinæ or conglomeratus in pure culture. From the blood the same organism was obtained mixed with staphylococcus aureus and albus.

Cultural and morphological characters of the streptococcus.—The streptococcus obtained from the above sources was identical in cultural and morphological respects with streptococcus scarlatinæ or conglomeratus, so often obtained from the throat in uncomplicated cases of the disease. Conglomeration was so intense in broth as to suggest a staphylococcus. The elements here were slightly bacillary. In agar condensation fluid coherent conglomeration was also marked, and the bacillary forms were better developed. The agar colonies showed the characteristic markings of streptococcus scarlatinæ, and some had a fine frilling of chains at their edge. The gelatine growth was very slow; the colonies impressed after 10 days showed capital spindles and bacillary forms. On the other hand, the essentially streptococcus character of the organism was well brought out in the condensation fluid of a blood-serum culture. In litmus milk strong acidity was shown and a firm clot produced in 3 days.

Pathogenicity.—But while this organism showed all the characteristic features of streptococcus scarlatinæ or conglomoratus in culture, it was found to possess no virulence for mice. Two mice, inoculated with the streptococcus from the kidney and from the blood respectively, appeared to be quite unaffected, and were alive and well two months later.

CASE V.—W. H., male, 9 months. "Scarlet fever. Cellulitis."

September 7th.—Vomiting. Diarrhœa.

September 8th.—Sore throat.

September 10th.—Nasal discharge.

September 11th.—Admitted. General punctate rash. Fauces injected. Cervical glands swollen. Temperature 100° C.

Cultivation from throat showed staphylococci and some bacilli. No diphtheria bacilli.

September 12th.—Temperature 105°. Nasal feeding.

September 13th.—Much swelling on right side of neck. Incision. No pus.

September 15th.—Temperature still high. Wound explored under chloroform.

September 17th.—Convulsions.

September 18th.—Death.

Autopsy, September 19th.—Brawny induration of the neck and purulent foci there. Tonsils purulent. The bronchial and mesenteric glands appear to the eye to be tubercular. Lungs show patches of broncho-pneumonia.

Demonstration of organisms in situ.—The heart's blood shows in five cover-glass specimens numerous streptococci in chains and in small groups. No other organisms seen. The spleen shows masses of streptococcus *in situ* in sections. Sections of a cervical gland show small groups of streptococcus. Sections of the kidney revealed no organisms.

Cultures.—Both aerobic and anaerobic cultures of the heart's blood showed streptococcus in the majority and staphylococcus albus in the minority. The spleen, kidney, and liver all gave pure cultures of the streptococcus. A broncho-pneumonic patch of the lung gave the streptococcus, and also staphylococcus albus and B. coli. One cervical gland gave a pure culture of the streptococcus. Another cervical gland showed a majority of the same, but also a few colonies of staphylococcus albus.

Summary.—The streptococcus was obtained from the following sources:—Heart's blood (mixed), spleen (pure), kidney (pure), liver (pure), lung (mixed), cervical gland (mixed), another cervical gland (pure).

Morphological and cultural characters of the streptococcus obtained.—In every case broth is made turbid. The growth, however, microscopically showed considerable conglomeration. In agar condensation fluid lace-work and bacillary forms are present. The streptococcus from the spleen, lung, and one cervical gland clotted milk, but from the other sources did not clot milk.

Virulence.—$\frac{1}{10}$ cc. of the patient's heart's blood was injected into a mouse. Suppuration occurred at the site of inoculation and death on the 3rd day, The streptococcus was demonstrated in masses in the heart's blood of the mouse. It was recovered in a majority, but mixed with staphylococcus albus from the same source and from the organs.

Comments.—Considering this streptococcus in the light of the other cases, I am inclined to think that this was the same micro-organism as obtained in the majority of cases from the scarlatinal cadaver. In this case, however, the growth in broth was atypical, so that no definite conclusion can be drawn. The cultures of this organism having all died, it is impossible to see if the faculty of bacillus-formation by the gelatine colonies is acquired on continued culture.

Case VI.—M.C., female, 2. "Septic scarlet fever."

Previous history.—Was admitted into Westminster hospital on January 27th, and operated on for contraction of right arm and leg. Developed measles soon after.

April 23rd.—Vomiting.

April 24th.—Rash. Suffers from chronic rhinorrhœa.

April 25th.—Admitted to M.A.B. hospital. General coarse punctate erythematous eruption. Tongue furred, peeling at tip. Fauces red and swollen. Temperature 101°; 12 hours later 103°.

April 26th.—Temperature 101°–103°. Some faucial ulceration.

April 27th.—Temperature 101·2°–102·4°. More rhinorrhœa. Rash very coarse and rather more dusky. Pulse more rapid, 190. Fauces no better.

April 28th.—Temperature 100·8°–102·4°. Pulse 180. More rhinorrhœa. Slept well. Taken food well. Left otorrhœa.

April 29th.—Fauces still ulcerated. Temperature 103°. Pulse 188. Has some difficulty in swallowing. Milk returns through nose.

April 30th.—Temperature 101·6°–102·4°. Pulse 180.

May 1st.—Temperature 101·6°–102·6°. Pulse 192. Takes food better. Fauces still ulcerated.

May 2nd.—Glands at angle of jaw swollen, very hard. No suppuration. Temperature 101°–103°. Pulse 186.

May 3rd.—Neck very red and swollen. No fluctuation.

May 4th.—Pulse 196. Temperature 103·4°. Slept well. Neck oedematous. No fluctuation.

May 6th.—Temperature 102°–104·2°. Neck less swollen. Still some oedema. No fluctuation. Tendency of skin to give way over brawny points of swelling. No signs of broncho-pneumonia found.

May 7th.—Diarrhœa (stopped by treatment). Temperature 100·2°—103·4°.

May 8th.—Temperature 105°. Pulse 198. Rapid respirations at 11 a.m. Patient died, 9.30 p.m.

Note.—The case therefore lasted 15 days.

Autopsy, May 9th.—Neck much swollen. Organs appear slightly congested. Intestines congested in places. Mesenteric glands enlarged.

Demonstration of organisms in situ.—The heart's blood shows diplococci and small chains *in situ*. Sections of spleen, kidney, and liver revealed no organisms.

Cultures.—One culture from the heart's blood direct gave streptococcus pure, another gave a majority of the same organism and one colony of staphylococcus aureus. In all cultures from dilutions of the heart's blood streptococcus alone was present. The spleen and liver gave pure cultures of streptococcus. The cultures from the kidney showed no growth. An agar plate from an enlarged mesenteric gland was overgrown with coli.

Summary.—Streptococcus was obtained from the heart's blood (mixed), spleen (pure), liver (pure).

Morphological and cultural characters.—Broth remained clear and the growth showed conspicuous conglomeration. In agar condensation fluid bacillary forms were seen in 48 hours, and lace-work arrangement was present. Litmus milk showed acid, but no clot.

The streptococcus formed bacillary forms in broth after some days' incubation. The gelatine colonies, however, showed no definite bacillary forms, either when the organism had recently been obtained from the scarlatinal cadaver, or after a year's culture outside the body. The elements, however, are rather more irregular in size and shape than are those of streptococcus pyogenes under similar conditions.

Virulence.—A mouse inoculated with the streptococcus obtained from the heart's blood of this case died in one day. The streptococcus was recovered.

Comments.—In spite of the non-development of bacillary forms in the gelatine colonies I am inclined to regard this streptococcus as probably derived from S. scarlatinæ rather than from S. pyogenes.

Case VII.—R.L., male, 6. "Scarlet fever. Perforating ulceration of palate. Stomatitis. Adenitis. Otorrhœa. Albuminuria."

September 27th.—Admitted 5th day of disease. Dark rash. Feeble pulse.

September 29th.—Desquamation. Throat foul. Yellow patches of stomatitis. Cervical glands swollen. Double otorrhœa.

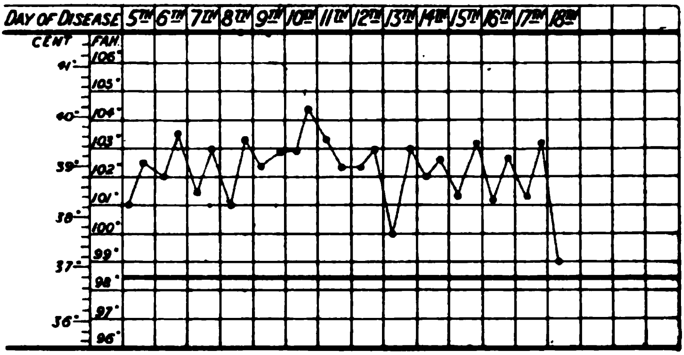
October 7th.—Perforation of palate. A slight cloud of albumen in the urine.

October 9th.—Pulse runs.

October 10th.—Patient died.

Note.—The disease therefore lasted 18 days.

Temperature Chart.



Autopsy, October 11th.—Stomatitis. Perforating ulceration of palate and suppuration of the tonsils. Adenitis and collection of pus in the cervical subcutaneous tissues. Double otorrhœa. Blotches of subcutaneous hæmorrhage. Copious desquamation over trunk and limbs. The lungs show a few patches of bronchopneumonia. The kidneys show acute nephritis, but contain no suppurating foci.

Demonstration of organisms in situ.—Cover-glass specimens of the heart's blood show no micro-organisms. A pipette containing some of it was therefore placed in the incubator for two days at 37° C. At the end of this time masses of streptococcus were present. Sections of the spleen and kidney revealed no micro-organisms.

Cultures.—Both aerobic and anaerobic cultures from the heart's blood gave a majority of streptococcus, and a minority of staphylococcus albus. The cervical pus gave pure cultures of streptococcus. An enlarged bronchial gland gave diplococcus pneumoniæ, streptococcus, and stapylococcus aureus. Cultures from the spleen showed a majority of streptococcus and one colony of staphylococcus albus. Cultures from the liver and kidney gave no growth.

Summary.—Streptococcus was obtained from the heart's blood (mixed), cervical pus (pure), bronchial gland (mixed), spleen (mixed).

Cultural and morphological characters of the streptococcus.—Broth remains clear. Conspicuous conglomeration is shown by the growth. Chain-formation is well marked also. Lace-work and bacillary forms are seen in agar condensation fluid. The gelatine colonies showed no bacillary forms at first, but, after continued cultivation outside the body, they are now beginning to develop bacillary forms by the fourth day on subculture. Litmus milk is not clotted except by the streptococcus from the bronchial gland.

Virulence.—The streptococcus from the bronchial gland was inoculated into a mouse. The animal died on the third day. The organism was recovered.

Comments.—The development of bacillary forms in the gelatine colonies, which it acquires on culture outside the body, taken together with its other characters, enables the streptococcus obtained in this case to be identified with streptococcus scarlatinæ or conglomeratus.

Case VIII.—A.F.C., female, 12. "Septic scarlet-fever."

Past history. Had diphtheria four years ago.

September 13th.—Headache, vomiting, sore throat, diarrhœa.

September 14th.—Nasal discharge.

September 15th.—Rash.

September 16th.—Admitted with general punctate rash. Delirious. Temperature 101°. Double otorrhœa.

September 22nd.—Much improved, but still delirious. Temperature 98°–100°.

September 24th.—Slight rigor. Temperature 103°.

September 26th.—Right elbow swollen and red.

September 27th.—Chloroform given. Right mastoid antrum opened and scraped out. Middle and posterior fossae exposed and found normal.

September 30th.—Skin and conjunctiva yellow. Bile in urine.

October 1st.—Both ankles swollen. Incised under chloroform.

October 2nd.—Coma and death.

Note.—The disease, therefore, lasted 19 days.

Autopsy, October 3rd.—Jaundice is well marked. Double otorrhœa. Both ankle joints suppurated. Lungs congested and suggest broncho-pneumonia in places. The liver is light yellow in colour and appears to be fatty. Spleen soft. Cervical glands not much enlarged. Tonsils and pharynx not apparently ulcerated. Both petrous bones show necrosis beginning, but no abscess.

Demonstration of organisms in situ.—The heart's blood shows short chains and diplococci. The spleen shows small masses of streptococcus *in situ.* The liver also shows masses of this organism in sections.

Cultures.—Both aerobic and anaerobic cultures were made of the heart's blood. In every case a pure culture of streptococcus was obtained. Pure cultures of the same were obtained from the spleen and liver. The kidney gave the streptococcus in a majority, and also a few colonies of staphylococcus aureus. A congested patch of the lung gave a majority of streptococcus and one colony of staphylococcus aureus. A cervical gland gave the streptococcus in the majority, and staphylococcus aureus and B. coli in a minority. A culture from pus from the interior of one ankle-joint yielded the streptococcus alone. An agar plate made from the secretion on the surface of the tonsil showed in the majority the same streptococcus, staphylococcus aureus, B. coli, and several colonies of an attenuated variety of the diphtheria bacillus.

Summary.—Streptococcus was obtained from the tonsil (mixed), cervical gland (mixed), lung (mixed), heart's blood (pure), spleen (pure), liver (pure), kidney (mixed), ankle-joint (pure).

Morphological aud cultural characters of the streptococcus obtained.—Broth remained clear and the growth of the streptococcus showed good conglomeration. In agar condensation fluid lace-work and bacillary forms were present. The latter were also seen in impressions of the agar colonies. The gelatine colonies at first showed no bacillary forms. The culture of this streptococcus obtained from the spleen, however, was kept up, and at the present time bacillary forms are beginning to appear in the gelatine colonies. The streptococcus obtained from each of the sources in this case was tested in litmus milk; in all a slight acid reaction was produced which increased later, but in no instance was the milk clotted.

Virulence.—$\frac{1}{10}$ cc. of the heart's blood of this case was injected into a mouse. The animal was apparently unaffected. A pure culture of the streptococcus obtained from the heart's blood was therefore injected into another mouse. The animal was dead in one day, and the organism was recovered. The escape of the first mouse was due, therefore, to the small quantity of this streptococcus that was present in the patient's heart's blood with which it was injected. A mouse injected with the streptococcus obtained from the surface of the tonsil in this case was dead in 24 hours, and the organism was recovered. A guinea-pig

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inoculated with the example of the diphtheria bacillus recovered from the same source was dead on the ninth day.

Comments.—The streptococcus engaged in this case can be identified with streptococcus scarlatinæ, owing to the fact that, besides its other characters, bacillus formation in the gelatine colonies is acquired on continued culture outside the body. The demonstration of this organism on the surface of the tonsil in this case points to that as the locality where the increase of virulence of this micro-organism takes place at the expense of some of its most distinctive morphological and cultural characters.

Case IX.—N.S., female 2½. "Scarlet fever."

September 24th.—Vomiting. Rash.

September 27th.—Admitted. Punctate erythema on trunk and limbs. Tongue coated and peeling at edges. Throat inflamed and increase of mucus. Copious rhinorrhœa. Restless.

October 2nd.—Throat very dirty. Diarrhœa. Tongue ulcerated.

October 3rd.—Cough.

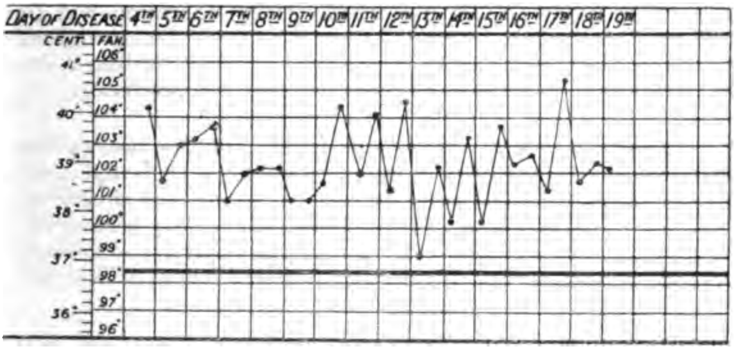
October 4th.—Double otorrhœa. Pulse rapid and weak. Conjunctivitis.

October 10th.—Broncho-pneumonia.

October 12th.—Died.

Note.—Albuminuria since admission. The case lasted 19 days.

Temperature Chart.



Autopsy, October 13th.—Tonsils ulcerated. Adenitis. Peritoneal fluid increased and piece of lymph on surface of liver. Heart enlarged and left ventricle thickened. Broncho-pneumonia.

Demonstration of organisms in situ.—Cover-glass specimens of the heart's blood show no organisms. Cover-glass specimens from the cervical gland show diplococci and short chains. Sections of the spleen and kidney show no organisms. Sections of a cervical gland, however, show masses of streptococcus towards the outer edge of the gland.

Cultures.—Cultures from the heart's blood show only B. coli. The spleen and liver also gave this organism. Cultures from the kidney showed no growth. A broncho-pneumonic patch of the lung gave diplococcus pneumoniæ, staphylococcus albus and aureus, and streptococcus. The cervical gland gave a pure culture of streptococcus. The surface of the tonsil gave diplococcus pneumoniæ, staphylococcus aureus, and streptococcus.

Summary.—Streptococcus was obtained from the cervical gland (pure), tonsil (mixed), and lung (mixed). Pneumococcus from the lung (mixed) and from the tonsil (mixed).

Morphological and cultural characters of the streptococcus obtained.—The streptococcus from the cervical gland and from the tonsil showed the morphological and cultural characters of streptococcus scarlatinæ or conglomeratus. In broth the fluid remained clear and the growth was very conglomerate. In agar condensation fluid the same conglomeration was seen. Bacillary forms and good chains developed both in broth and in agar fluid. The agar colonies showed the characteristic markings of S. scarlatinæ or conglomeratus. The streptococcus from the cervical gland would not grow on gelatine at 20° C. but that from the tonsil grew on that medium in the slow and characteristic manner of streptococcus scarlatinæ or conglomeratus. Both the streptococcus from the tonsil and also that from the cervical gland clotted milk and produced a strongly acid reaction.

On the other hand, the streptococcus from the lung was similar to that which had been obtained most frequently from the scarlatinal cadavers already described. Conglomeration was conspicuous in broth; lace-work was seen in agar condensation fluid; and both in the latter and on the surface of agar, bacillary forms were developed. No clotting of litmus milk was produced.

Virulence.—A mouse injected with ½ cc. of the heart's blood of this case was apparently quite unaffected. The streptococcus from the tonsil and that from the cervical gland each produced a transient suppuration from which the mouse rapidly recovered in each instance. The example of diplococcus pneumoniæ from the tonsil killed a mouse in one day, and in the blood of the latter the capsules of the pneumococci were demonstrated.

CASE X.—J.M., male, 4. "Scarlet fever."

Previous illness: Measles.

April 8th.—Swollen glands. Nasal discharge.

April 9th.—Sore throat: "croup."

April 11th.—Admitted. Fauces inflamed. Soft defined exudation on tonsils, extending to sides of uvula. Cervical glands enlarged. Rhinorrhœa. Diphtheria antitoxin given.

April 12th.—Exudation on tonsil.

April 14th.—Fauces clean except for mucus.

April 15th.—Ulceration of uvula and patch of exudation on right tonsil. Glands more enlarged on left side.

April 16th.—Said to have had a fit during the night. A few rhonchi in chest.

April 17th.—Neck more swollen on left side. Temperature up to 106°.

April 18th.—Temperature normal. Right otorrhœa.

April 19th.—Deep perforating ulceration of right side of soft palate and ulceration of left tonsil, and superficial ulceration of base and sides of uvula. Glands swollen. Profuse rhinorrhœa. Occasional regurgitation of fluids through nose. Patient very restless.

April 20th.—Double otorrhœa. Diarrhœa better. Occasional rhonchus in chest. Suspicion of desquamation. Cultivation from throat shows cocci. No diphtheria bacillus obtained.

April 22nd.—Deep ulceration of right tonsil and uvula, fringe of soft palate destroyed. Slough size of sixpence on anterior portion; perforation of soft palate. Tongue dry and sticky. Lips fissured. Bleeding profusely from nose. Double offensive otorrhœa and adenitis. Fingers peeling. General wasting.

April 23rd.—Cannot swallow. Pulse soft, regular, 133. Cough.

April 24th.—Right half of soft palate has ulcerated away for nearly the whole of its extent. 7.30 p.m., convulsions, left side of face and left arm affected. 10.15 p.m., ditto.

April 25th.—8 p.m., convulsions severe. 11.30 p.m., repeated.

April 27th.—Temperature 105·6°. Pulse 172. Small regular ulceration extended on left side. Both halves of soft palate and greater part of uvula is destroyed. Head retracted. Cheeks flushed. No convulsions since midnight.

April 28th.—Patient died of cardiac failure at 12.15 a.m. The disease therefore lasted for 20 days in this case.

Autopsy, April 29th.—There was general fine flaky desquamation all over the trunk and limbs. Some but not extreme emaciation. Extensive ulceration of the fauces was seen. The left tonsil and a good deal of the right had disappeared—only a small fragment of the uvula remained. Both anterior pillars, especially the left, were most extensively eaten away, together with portions of the soft palate between the anterior pillars and the base of the uvula. The posterior pillars were also considerably ulcerated. There was only one enlarged gland on the right side of the neck. Liver slightly nutmeg. Lungs, heart, spleen, kidneys, stomach, intestines, and bladder normal. It was not permitted to examine the brain.

Dr. Goodall's note on this case is as follows:—The above case, though sent in as a case of diphtheria, and though there was no history or evidence of a rash, was undoubtedly one of scarlet fever.

Demonstration of organisms in situ.—Cover-glass preparations were not made of the heart's blood in this case. Sections of the spleen, kidney, and liver revealed no organisms.

Cultures.—All the cultures from the heart's blood of this case yielded streptococcus pure. Cultures from the spleen showed the same organism in the majority, but also several colonies of B..coli. The kidney and liver both gave pure cultures of streptococcus. A culture from an enlarged cervical gland gave staphylococci only.

Summary.—Streptococcus was obtained from the heart's blood (pure), spleen (mixed), kidney (pure), liver (pure).

Cultural and morphological characters of the streptococcus obtained.—Broth remains clear and the growth shows conspicuous conglomeration. In agar condensation fluid bacillary forms are seen, and some lace-work. The agar colonies show some bacillary forms. The gelatine colonies, however, showed none when examined, which was soon after the organism had been obtained from the scarlatinal cadaver. In litmus milk an acid reaction is produced, but no clot.

Virulence.—A mouse inoculated with the streptococcus from the heart's blood of this case showed local suppuration, and died on the ninth day. The organism was recovered. Another mouse inoculated at the same time as the first and with a similar dose showed some suppuration at the site of inoculation, but recovered

Comments.—The streptococcus obtained in this case is similar to that obtained most frequently in the previous cases. While it is highly probable that this organism is streptococcus scarlatinæ it cannot be absolutely identified with it at present.

DIAGRAMS *showing* I *the Streptococcus yield in the 10 fatal cases of Scarlatina examined; and* II *the effect on milk of these same Strepto cocci.*

I

CASE	I	II	III	IV	V	VI	VII	VIII	IX	X
Tonsil			+					+	+	
Cervical Gland	+	✳	✳		+✳		*Vide Pus*	+	✳	−
Lung		+			+			+	+	
Bronchial Gland							+			
Heart's Blood	✳	✳	✳		+	+	+	✳	−	✳
Spleen	✳	○	✳		✳	✳	+	✳	−	+
Kidney	✳	○	✳	✳	✳	○	○	+	○	✳
Liver	○	✳	+		✳	✳	○	✳	−	✳
Pus							✳	✳		
Blood				+						

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II

I	II	III	IV	V	VI	VII	VIII	IX	X
		−					−	+	
−	+	−		+ −			−	+	
	−			+			−	−	
						+			
−	−	−		−	−	−	−		−
−		+		+	−	−	−		−
−		−	+	−			−		−
	−	−		−	−		−		−
						−	−		
			+						

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✳	*pure cultures of Strepto coccus.*
+	*Strepto coccus present; not pure.*
−	*Strepo coccus absent; other orgs present.*
○	*no growth obtained.*

+	*Clots milk.*
−	*no clot.*

ANALYSIS OF TEN FATAL CASES OF SCARLATINA.

ANALYSIS OF TEN FATAL

DURING LIFE.

No. of Case.	Duration of Disease.	Complications.	Nephritis.	Broncho-pneumonia.	Throat Culture.
I.	4 days	A remarkably pure case.			
II.	6 days	Adenitis; broncho-pneumonia.		Present:	Yields only streptococci; no diphtheria bacillus.
III.	7 days	Rhinorrhœa; adenitis; slight broncho-pneumonia.	No albuminuria	Present:	
IV.	8 days	Albuminuria	Urine contains blood and albumen.		Staphylococci; no diphtheria bacillus.
V.	11 days	Adenitis; brawny induration of neck; broncho-pneumonia.		Present:	Staphylococci, and some bacilli: no diphtheria bacillus.
VI.	15 days	Chronic rhinorrhœa at onset; otorrhœa; adenitis.			
VII.	18 days	Perforating ulceration of palate: stomatitis; otorrhœa; adenitis; broncho - pneumonia; albuminuria.	Urine contains large trace of albumen.	Present:	
VIII.	19 days	Rhinorrhœa; otorrhœa; adenitis; broncho-pneumonia; suppurative arthritis; jaundice.		Present:	
IX.	19 days	Conjunctivitis; rhinorrhœa; otorrhœa adenitis; broncho - pneumonia; albuminuria.	Albuminuria since admission.	Present:	
X.	20 days	Perforating ulceration of palate; rhinorrhœa; otorrhœa; adenitis.			Cocci obtained; no diphtheria bacillus.

CASES OF SCARLATINA.

AFTER DEATH.

Tonsil Surface.	Cervical Gland.	Lung.	Heart's Blood.	Spleen.	Kidney.	Liver.
	Streptococcus in vast majority, and 1 col. of staph. albus.		Groups of streptococci *in situ* Pure cultures of same.	Pure cultures of streptococcus.	Pure cultures of streptococcus.	No growth.
	Streptococcus masses *in situ*. Pure cultures streptococcus.	Streptococcus, B. coli.	No orgs. *in situ* seen. Pure cultures of streptococcus.	No growth	No growth ..	Pure cultures of streptococcus.
Streptococcus infiltrates tonsil (sections). Culture shows streptococci.	Masses of streptococcus *in situ*. Pure cultures streptococcus.		Masses of streptococcus *in situ*. Pure cultures of streptococcus.	Pure cultures of streptococcus.	Masses of streptococcus *in situ*. Pure cultures of streptococcus.	Streptococcus majority in culture; also a few cols. of B. coli.
			Blood from small vein yields majority of streptococcus, also staphs. aureus and albus.		A few diplococci *in situ*. Pure culture of streptococcus.	
	Masses of streptococcus *in situ*. One gland gives pure streptococcus; another majority same and 1 col. staph. albus.	Streptococcus, staph. albus, B. coli.	Groups of streptococcus *in situ*. Cultures show majority of same, and also some cols. of staph. albus.	Masses of streptococcus *in situ*. Pure cultures of streptococcus.	Pure cultures of streptococcus.	Pure cultures of streptococcus.
			Streptococcus *in situ*. Cultures show vast majority of same, and also 1 col. staph. aureus.	Pure cultures of streptococcus.	No growth ..	Pure cultures of streptococcus.
	Cultures from cervical pus give pure streptococcus.	Pneumococcus, staph. aureus, streptococcus; all obtained from bronchial gland.	Streptococcus *in situ* after incubation. Cultures show vast majority of same, and 2 cols. staph. aureus.	Streptococcus majority in cultures; also 1 col. staph. albus.	No growth ..	No growth.
Streptococcus, staph. aureus, B. coli, B. diphtheriæ (attenuated).	Streptococcus *in situ*. Cultures show majority of same; also present staph. aureus and B. coli.	Streptococcus in majority, and 1 col. staph. aureus obtained.	Streptococcus *in situ*. Pure cultures of same.	Masses of streptococcus *in situ*. Pure cultures of same.	Streptococcus majority, and also 2 cols. staph. aureus obtained.	Masses of streptococcus *in situ*. Pure cultures of same.
Streptococcus, staph. aureus, pneumococcus (majority).	Large masses of streptococcus *in situ*. Pure cultures of same.	Pneumococcus (majority), staphs. aureus and albus, streptococcus.	B. coli	B. coli ..	No growth ..	B. coli.
	Staphs. aureus and albus.		Pure cultures of streptococcus	Majority of streptococcus. A few cols. of B. coli.	Pure cultures of streptococcus.	Pure cultures of streptococcus.

App. B, No. 2.

On the Bacteriology of Scarlatina; by Dr. Gordon.

THE DEMONSTRATION of MICRO-ORGANISMS IN SITU in the BLOOD and TISSUES of the SCARLATINAL CADAVER.

Heart's blood.—Cover-glass preparations of the heart's blood were made in eight cases and well searched. Streptococcus was demonstrated *in situ* in five cases, viz., in 1, 3, 5, 6, and 8. In cases 3 and 5 it was especially prevalent. In cases 2, 7, and 9 no micro-organisms were detected in cover-glass specimens of the heart's blood. In case 2, however, a pure culture of streptococcus was obtained by using a considerable quantity of the heart's blood. In case 7 a pipetteful of the heart's blood was incubated at 37° C. for two days, when it was found to be swarming with streptococcus. This organism had meanwhile been recovered by cultures from the heart's blood. In case 9 the only organism obtained from the heart's blood was B. coli.

Spleen.—A piece of the spleen was hardened, cut, and stained with eosine and methylene blue, or with Loeffler's blue, or by Gram's method, in the following cases:—1, 2, 3, 5, 6, 7, 8, 9, and 10. In only two instances, viz., in cases 5 and 8, were organisms demonstrated *in situ.* In both these cases conglomerate masses of streptococcus were seen lying in the splenic tissue.

Kidney.—Sections of the kidney were examined in cases 1, 2, 3, 5, 6, 7, 8, 9, and 10. In only one instance, viz., in case 3, were organisms demonstrated *in situ.* In that instance small masses of streptococcus were seen in some of the renal blood vessels.

Liver.—Sections of the liver were examined in cases 2, 3, 6, 8, and 10. In one instance only, viz., in case 8, were organisms seen *in situ.* In this case, however, large conglomerate masses of the streptococcus were seen lying in the hepatic tissue. It will be remembered that the same case developed jaundice a few days before death.

Lung.—Sections of bromcho-pneumonic patches were examined in cases 2 and 9. In neither were any micro-organisms demonstrated *in situ.*

Cervical gland.—In all cases where sections of an enlarged cervical gland were examined, viz., in cases 2, 3, 5, 8, and 9, conglomerate masses of streptococcus were demonstrated *in situ.* They were as a rule located chiefly towards the outer edges of the gland in the "lymph channel." In all cases in which a cervical gland was examined one of those nearest to the tonsil was selected.

Tonsil.—In case 3 sections were made of the tonsil and stained in the usual way. Streptococci were demonstrated *in situ* invading and infiltrating the tonsillar tissue, and spreading by lymphatic paths into the deeper tissues. The tendency of these streptococci to conglomerate into small masses was evident at places.

In all the above instances therefore, although a special look-out was kept, no other micro-organism was demonstrated *in situ* in the blood or tissues of the scarlatinal cadaver than streptococcus. In all cases where the microscope revealed this organism its presence was also proved by the culture method. On the other hand, in many of the instances in which no organism was detected by microscopical examination the same tissue had yielded streptococcus by the culture method.

FURTHER EXAMINATION of the HEART'S BLOOD of the SCARLATINAL CADAVER.

The investigation of the heart's blood has not been limited to a microscopical examination and to making ordinary aerobic cultures. Anaerobic cultures were also made in cases 3, 5, 7, and 8. The result, however, of anaerobic conditions was exactly the same as that of aerobic ; no further micro-organisms being found by this means. In four instances, moreover, viz., in cases 3, 5, 7, and 9, some of the heart's blood was introduced directly into mice. The results were as follow :—

In Case 3 the heart's blood was found microscopically to contain the streptococcus more plentifully than in any other case. ¼ cc. of this blood injected into a mouse resulted in the death of the animal on the fourth day. No local suppuration was found, but acute general septicæmia had been produced. The heart's blood of the mouse contained the streptococcus in large numbers, and this organism was recovered in pure culture.

In case 5 the heart's blood contained large quantities of streptococcus. Cultures showed this organism in an overwhelming majority, but also a few colonies of staphylococcus albus. $\frac{1}{10}$ cc. of this blood was injected into a mouse. Suppuration occurred at the site of inoculation and the animal died on the third day. The streptococcus was found in numbers in the heart's blood of this mouse, and recovered, in a large majority, but mixed with staphylococcus albus, by culture.

The heart's blood of case 8 contained the streptococcus very sparsely. A pure culture of this organism was obtained. $\frac{1}{10}$ cc. of the blood of this case was introduced into a mouse. The animal remained apparently unaffected.

In case 9 the heart's blood contained no streptococcus, but only B. coli. ½ cc. of this blood was introduced into a mouse. The animal remained unaffected.

It follows from the above experiments that the heart's blood of the scarlatinal cadaver is virulent for mice in proportion as it contains the streptococcus ; when this organism is only sparsely present, and when it is absent, no virulent effect is seen. By anaerobiosis, therefore, and by injection of the heart's blood directly into a mouse, no other organisms are developed than are found by ordinary microscopical examination coupled with aerobic cultures. There is no evidence then of the presence of other pathogenic organisms than those which have already come under notice.

ORGANISMS other than STREPTOCOCCI obtained in CULTURES from the TEN FATAL CASES of SCARLATINA EXAMINED.

(1) *Diplococcus pneumoniæ.*—This organism was obtained from two of the fatal cases examined. In case 6 it was the most numerous organism in a culture from an enlarged bronchial gland. In case 9 it was obtained from two sources, viz., a broncho-pneumonic patch of the lung, and from the secretion on the surface of the tonsil. The organism was recognised in all three instances by its cultural and staining characters, and especially by its capsule. In the first two instances the capsule was well seen in the original growth in agar condensation fluid inoculated direct, and thus containing some blood. In the case of the culture from the tonsillar secretion of case 9, a mouse injected died in one day, and capsules were demonstrated round the diplococci in the blood of the mouse. The presence of the pneumococcus in the secretion on the surface of the tonsil in this case was no doubt due to its having come from the lung in the sputum. That much significance should not be attached to its presence on the surface of the tonsil in this case is plain also from its absence in cultures from the cervical gland. Clearly then the pneumococcus did not penetrate the tonsil in the same way that streptococcus scarlatinæ evidently did in this case.

Staphylococci.—Staphylococcus albus liquescens was obtained from the following sources:—Case 1, cervical gland; 4, blood; 5, cervical gland, lung, heart's blood; 7, spleen; 9, lung; and 10, cervical gland. Staphylococcus aureus liquescens was obtained from case 4, blood; 6, heart's blood; 7, bronchial gland and heart's blood; 8, tonsil, cervical gland, lung, kidney; 9, tonsil, lung; 10, cervical gland.

Bacillus diphtheriæ was obtained from the tonsillar secretion of case 8. A guinea-pig inoculated with it died 10 days after. The organism was recovered from the site of inoculation. This culture of the diphtheria bacillus grew more feebly than that organism usually does.

B. coli was present in several cases. No importance need be attributed to the presence of this organism, which is a well-recognised post-mortem contamination.

Sterile cultures.—On four out of seven occasions when no growth was obtained the cultures had been inoculated from the kidneys.

THE STREPTOCOCCI obtained from the SCARLATINAL CADAVER.

In the 10 cases examined bacteriologically after death from scarlatina, cultures were made from 56 sources. Forty-five of these sources yielded streptococcus, and on 26 occasions in absolutely pure culture. It follows therefore that the chief bacteriological interest attaches to these streptococci.

The 45 streptococci obtained from the above cases admit of differentiation in the first place according to their behaviour towards milk. Ten clot milk, and 35 fail to do so, even during a month's incubation at 37° C. Of the 10 that clot milk, six are in morphological and cultural respects identical with the 35 that fail to do so. They will, therefore, be considered with that class The remaining four streptococci, however, that clot milk, can from their morphological and cultural characters be at once identified with streptococcus scarlatinæ or conglomeratus.

(*a.*) *Streptococci that can be immediately identified with streptococcus scarlatinæ or conglomeratus.*

The four organisms now under consideration came from two cases and two sources in each case. They were obtained from case IV., kidney (pure culture), and blood (mixed culture); and from case IX., cervical gland (pure culture), and tonsil (mixed). I will now describe these four streptococci in detail.

Case IV.—Kidney.—In a broth culture from the juice of the kidney of this case the growth was that of type A, streptococcus scarlatinæ. A small very coherent mass of growth appeared at the foot of the clear broth after 17 hours' incubation at 37° C. It was found necessary to squeeze a piece of the growth between two cover-glasses in order to get a layer thin enough for microscopical examination of the individual elements. The latter were found to be mostly coccus in form, but many of them showed a distinct inclination to a slightly bacillary shape. No very distinct rods, however, were seen. A trace of the growth was transferred to agar. After 17 hours' incubation conglomerate masses of growth were seen in the condensation fluid. So coherent were these that it was again necessary to crush the growth to obtain a layer thin enough for microscopical purposes. Bacillary forms were then found to be much more evident in this medium than had been the case in broth. An agar plate was now made. All the colonies that developed were characteristic streptococcus scarlatinæ colonies. From a single colony the above observations were repeated and confirmed. A blood-serum tube was now inoculated. Flocculi appeared in the condensation fluid next day, and these on examination turned out to be composed of capital streptococcus chains. The contrast between the growth in agar condensation fluid and in serum condensation fluid was great. The growth on the surface of solidified blood serum showed a few bacillary forms amongst a majority of cocci. This streptococcus was found to clot litmus milk in 48 hours with a strongly acid reaction. On gelatine the slow growth of streptococcus scarlatinæ was well seen, and impression preparations showed good spindle and bacillary forms.

From its morphological and cultural characters, therefore, this streptococcus could be at once identified with streptococcus scarlatinæ or conglomeratus. The culture from the blood of this case had the same morphological and cultural characters as the above. These two streptococci were next injected into mice. Both animals, however, appeared to be quite unaffected, and were alive and well two months later.

Case IX.—Cervical gland.—The broth culture from this source was as typical of streptococcus scarlatinæ as the above. In this

On the Bacteriology of Scarlatina; by Dr. Gordon.

instance, however, chain-formation was better seen. Bacillary forms were seen in the growth in broth, in agar condensation fluid, in the agar, and in the gelatine colonies. Litmus milk was clotted with a strongly acid reaction in 48 hours. The streptococcus refused to grow on gelatine at 20° C. The streptococcus isolated from the tonsil of this case had the same characters as the above, but grew on gelatine. The growth on the latter medium was characteristic of S. scarlatinæ, and spindle and bacillary forms were present in the colonies.

These two streptococci therefore had morphological and cultural characters bearing such a strong resemblance to those of S. scarlatinæ as to admit of definite identification with that organism. A mouse was injected with each streptococcus in the usual way. In each instance the mouse showed slight local suppuration, from which, however, it rapidly recovered. Both animals were alive and well two months afterwards.

Conclusion.—In all four instances where a streptococcus was recovered from the scarlatinal cadaver, having morphological and cultural characters typical of streptococcus scarlatinæ or conglomeratus, it was found to possess little or no virulence for mice.

(*b.*) *Streptococci that cannot be immediately identified with streptococcus scarlatinæ or conglomeratus.*

The streptococcus now to be described was obtained from 41 out of the 45 sources that yielded a streptococcus growth. This therefore is by far the most frequently obtained type. Although six of the 41 individual organisms now under consideration clotted milk, their morphological and cultural characters were the same as those of the remaining 35 that failed to do so. The characters of this organism, which is alluded to throughout the rest of this report as the streptococcus most frequently obtained from the scarlatinal cadaver, I will now endeavour to describe.

Broth.—The fluid as a rule remains perfectly clear, but in some exceptional cases turbidity is produced. The growth occurs as a coherent flocculent mass or masses at the bottom of the tube. There is found to be some resistance to separation of the growth in several cases, but this is a variable phenomenon. In no instance have I found it so marked as in the case of typical streptococcus scarlatinæ or conglomeratus. Microscopically conglomeration is conspicuous, and in some cases so well marked that it is difficult to make out the chains. The degree, however, to which this character is displayed does not rival that shown by typical streptococcus scarlatinæ microscopically. It is, however, as well marked in some of these cultures from the scarlatinal cadaver as in some of the less conglomerate forms of streptococcus scarlatinæ obtained from the scarlatinal tonsil in mild cases of the disease. Conglomeration in any case must be considered a marked feature of the streptococcus most frequently obtained from the scarlatinal cadaver. Chain-formation is also well developed in some instances in broth. The elements in this medium are almost entirely coccus in shape. Bacillary forms are in my experience rare, though in exceptional cases they may be striking.

In the *condensation fluid of an agar culture* the growth of this streptococcus may be more characteristic than in broth. I have in many cases now had the opportunity of examining the growth in this medium when inoculated direct from scarlatinal tissues as well as from subcultures obtained from a single colony of the streptococcus. In the case of an inoculation from the scarlatinal tissues, such as for instance from a cervical gland or elsewhere, a point, in itself a small one, is at the same time very characteristic when a pure culture of this streptococcus is obtained. I refer to the *dawn* of the growth. After one night's incubation at 37° C. the clearness of the small collection of condensation fluid at the foot of the agar tube is disturbed here and there by the appearance of one or more small white conglomerate masses of growth. At this time there may be as yet no growth on the surface of the agar. Microscopically the growth shows two features well, namely, conglomeration and chain-formation. The combination of these two gives rise to the "lace-work" arrangement previously mentioned as a characteristic in this medium of streptococcus scarlatinæ after passage through mice. Many variations of the pattern are met with. Sometimes the chief feature is the chain-work, in which case long and numerous chains are seen to aggregate here and there to form masses. In other cases conglomeration prevails and chains are less prominent. But in agar condensation fluid another character is seen, that has already been described as so noticeable a feature of S. scarlatinæ after passage through mice, namely, bacillus-formation. The bacillary forms are of the same shape in both cases, viz., they have pointed or rounded ends and are often curved. Occasionally also spindles are seen. In mentioning bacillary forms of the streptococcus under consideration, however, it must be borne in mind that, as in the case of streptococcus scarlatinæ after passage through mice, bacillary forms are much in the minority. The *agar colonies* are round or oval, the larger of a greyish hue, and many of the smaller ones more transparent. Under a low power they are seen to be granular, and while the majority preserve a firm outline, a minority may show considerable chain-work at their edge, Rarely, also, a piece of convoluted chain-work is seen. Impression preparations of the agar colonies after one night at 37° C. show bacillary or spindle-shaped forms here and there among a majority of coccus-shaped elements.

Gelatine colonies.—Small bluish grey colonies develop along the track of the needle on gelatine in the course of 48 hours. Growth may be rather faster than in the case of streptococcus scarlatinæ isolated from the throat in mild cases, but it is not faster than that of the same after passage through mice. Impression preparations of the gelatine colonies, made when the organism is recently obtained from the body, or in some cases even when it has been in culture for a year, show no definite bacillary forms. If a large number of specimens are searched a few slightly bacillary forms may be seen, but I have not found that they occur in sufficient numbers in these cases to be characteristic. At the same time many of the coccus like elements in impressions of the gelatine colonies tend to exceed the average size of the specimen. In *litmus milk*, as mentioned previously, acidity is marked, but, as a rule, no clot is produced.

Pathogenicity.—The above streptococcus obtained by culture from the heart's blood of the scarlatinal cadaver, was in four instances hypodermically injected into mice. A mouse inoculated with the streptococcus grown from the heart's blood of case I. showed some suppuration at the site of inoculation, and died on the 17th day. The streptococcus from the heart's blood of case VI. produced death in a mouse in one day; as was also the case with that obtained from the heart's blood of case VIII. Two mice were injected with the streptococcus from the heart's blood of case X. Both developed some pus at the site of inoculation, one died on the 17th day, the other recovered. In cases III. and VIII. the same streptococcus was recovered from the surface of the tonsil, and in both instances a mouse was inoculated. The streptococcus obtained from the tonsil of case III. caused local suppuration, and the mouse died on the 18th day. In case VIII. the streptococcus from the tonsil produced death in a mouse in one day. Out of seven mice inoculated with this streptococcus therefore only one recovered. The others died in a time varying from one to 18 days. In the case of those that survived the first few days, local suppuration was produced. The appearance of these mice post-mortem was that of acute septicæmia. In all cases the organism was recovered. It must be added that I have not hitherto succeeded in obtaining bacillus conglomeratus from these mice. This form however, was hardly to be expected, for the few experiments at present to hand with the streptococcus of the scarlatinal tonsil in mild cases, after its virulence has been raised by passage through a mouse, indicate that with increase of virulence, streptococcus scarlatinæ loses its bacillus-forming tendency and affects more especially the streptococcus shape.

Summary of the characters of this streptococcus.—It will be seen from the above that the streptococcus recovered most frequently from the blood and tissues of the scarlatinal cadaver in the 10 cases examined shows conspicuous conglomeration in broth. Chains are apt to be at times long and numerous in the same medium, as also in the agar condensation fluid. Lacework and bacillary forms are features of the growth in the latter medium. While bacillary forms are seen on searching impression preparations of the agar colonies they are not seen in impression preparations of the gelatine colonies, when the organism is recently obtained from the scarlatinal cadaver. In litmus milk acidity is produced, but as a rule no clot. The streptococcus is very virulent to mice.

THE RELATIONSHIP of the STREPTOCOCCUS most frequently RECOVERED from the SCARLATINAL CADAVER to STREPTOCOCCUS SCARLATINÆ or CONGLOMERATUS.

On comparing the streptococcus most frequently recovered from the scarlatinal cadaver with streptococcus scarlatinæ or conglomeratus so frequently isolated from the throat in mild cases of scarlatina, it will be seen that, although there is a general resemblance between these two organisms, there are also considerable differences. I will now therefore compare these two organisms together at some length.

Broth 1 *day* 37° C.—In both cases the fluid is clear, and conspicuous conglomeration is shown. The coherent conglomeration that may be shown by the streptococcus from the tonsil is in excess of that exhibited by the streptococcus from the cadaver. The extent, however, to which conglomeration is shown by the latter is both striking and suggestive.

Agar condensation fluid 2 *days* 37° C. In both cases conglomeration is seen. Lace-work and bacillary forms, however, are not features of the streptococcus from the tonsil in mild cases of the disease, but are commonly seen in that from the cadaver.

Litmus milk 37° C.—Whereas the streptococcus from the tonsil often clots the milk with a strongly acid reaction, that from the cadaver very seldom does so.

Agar colonies 1 *day* 37° C.—The growth on agar of the streptococcus most frequently derived from the scarlatinal cadaver is more profuse than that of the streptococcus of the scarlatinal tonsil in mild cases of the disease. Again, the characteristic shapes and markings of the colonies of streptococcus scarlatinæ or conglomeratus are not shown by the streptococcus most frequently derived from the scarlatinal cadaver. Chain-work is also generally much less evident in the latter case. On the other hand, impression preparations show that bacillary forms occur in the agar colonies in both cases, though they are less prevalent in the case of the streptococcus from the scarlatinal cadaver.

Gelatine colonies 20° C., 3*rd or* 10*th day.*—The appearance of the growth in the two cases is similar, but not identical, the streptococcus from the scarlatinal cadaver tending to grow slightly faster than the other. The shapes of the colonies are similar in both cases. Nodules also are occasionally seen in the gelatine colonies of the streptococcus from the scarlatinal cadaver. Impression preparations of the latter, however, fail to show the definite bacillary and spindle-shaped forms often seen in the case of the streptococcus from the tonsil.

Pathogenicity.—The virulence for mice of the streptococcus from the scarlatinal cadaver is greatly in excess of the streptococcus from the tonsil in mild cases of the disease.

Conclusion.—The growth in broth of the streptococcus most frequently derived from the scarlatinal cadaver is very suggestive of streptococcus scarlatinæ or conglomeratus. The bacillus-formation seen in the agar colonies of the former organism is also a suggestive point of resemblance. In other respects, however, the characters of the streptococcus most frequently derived from the scarlatinal cadaver, though they bear a general resemblance to those of streptococcus scarlatinæ or conglomeratus, are at the same time sufficiently distinct to make it necessary to treat of each separately.

But it has been shown that the characters of streptococcus scarlatinæ or conglomeratus are considerably modified by passing that organism through a mouse. Moreover, if comparison be made between the streptococcus most frequently recovered from the scarlatinal cadaver and the streptococcus most frequently recovered from the bodies of mice that succumb to infection with streptococcus scarlatinæ or conglomeratus, it will be seen that they have much in common. Some of the respects indeed in which the streptococcus of the scarlatinal cadaver shows disagreement with streptococcus scarlatinæ are in point of fact the very same as those in which the modified form of streptococcus scarlatinæ differs from its parent. It is well therefore to compare the streptococcus most frequently derived from the bodies of the mice that succumb to S. scarlatinæ with the streptococcus most frequently derived from the scarlatinal cadaver.

Broth 1 *day* 37° C.—The streptococcus of the scarlatinal cadaver is a good deal more like streptococcus scarlatinæ or conglomeratus in this medium than is the modified form of the latter derived from the mouse. The former shows conspicuous conglomeration, the latter little or none.

Agar condensation fluid 37° C. 2 *days*.—The resemblance of the growth of both organisms in this medium is very striking. Lace-work and bacillary forms are features of both.

Litmus milk 37° C.—In neither case is clotting as a rule effected.

Agar colonies 37° C. 1 *day*.—To the eye and under a low power these are indistinguishable in the two cases. Both also show bacillary forms, though these are more prevalent in the case of the streptococcus from the mouse.

Gelatine colonies 20° C. 3*rd and* 10*th day*.—The appearance and rate of growth is the same in both cases. The streptococcus from the mouse, however, shows bacillary forms, a feature that is not seen in the gelatine colonies of the streptococcus most frequently obtained from the scarlatinal cadaver when recently obtained from that source.

Pathogenicity.—In virulence for mice both streptococci are now similar.

Summary.—In broth culture the streptococcus most frequently derived from the scarlatinal cadaver is actually more like streptococcus scarlatinæ than is the derivative of that organism obtained from the bodies of mice. On the other hand, the latter shows bacillary forms in its gelatine colonies, a feature not seen in the case of the streptococcus when recently obtained from the scarlatinal cadaver. In other respects these two streptococci are identical.

In one instance, however, the modified form of streptococcus scarlatinæ, obtained by passing that organism through a mouse, was passed further through a guinea-pig. The points in which further modification of its characters were found to have taken place were in respect to its growth in broth, and in the microscopical appearance of impression preparations of its gelatine colonies. In the former and in the latter, as in all other respects, this derivative of streptococcus scarlatinæ or conglomeratus of the scarlational tonsil in mild cases of the disease was now identical with the streptococcus most frequently derived from the scarlatinal cadaver.

It follows from the above that streptococcus scarlatinæ or conglomeratus, obtained from the throat in a mild case of scarlatina, can, by passage through a mouse and then through a guinea-pig, be modified in those very respects in which it originally differed from the streptococcus most frequently obtained from the scarlatinal cadaver. In morphological, cultural, and pathogenic respects these two streptococci were now identical.

The above evidence, however, encouraging though it may be, is not absolutely conclusive. The increase of virulence of streptococcus scarlatinæ or conglomeratus has taken place at the expense of some of the chief morphological and cultural characters by which that organism is distinguished from the streptococcus medius or pyogenes. It remained, therefore, to see if the streptococcus most frequently recovered from the scarlatinal cadaver was "fixed" in morphological and cultural respects, as the examples of streptococcus pyogenes at present examined appear to be, or whether it could regain some of its more distinctive morphological and cultural characters.

A recent revision of all living cultures of the streptococcus most frequently obtained from the scarlatinal cadaver has resulted in the discovery of the acquirement of a further characteristic on the part of three out of the five examples of this organism at present in stock. It will be remembered that the streptococcus obtained from the pleural effusion that occurred in a case of scarlatina was at first identical in all ways with the streptococcus most frequently derived from the scarlatinal cadaver. After a year's culture in artificial media, however, that streptococcus has acquired the power of "bacillus formation" in its gelatine colonies. This further feature then enabled me to definitely identify the streptococcus obtained from the pleural effusion with streptococcus scarlatinæ or conglomeratus. Recently therefore a re-examination was made of these five remaining examples of the streptococcus most frequently obtained from the scarlatinal cadaver. They were from the following sources:—Case 1, cervical gland; case 2, cervical gland and heart's blood; case 6, heart's blood; case 7, heart's blood ; and case 8, spleen. I have found that in the case of the streptococcus from cases 1 and 7, the irregularity in size and shape of the elements seen in impression preparations of the gelatine colonies does not yet amount to definite bacillus formation. On the other hand, the streptococci from cases 1, 7, and 8, show in their gelatine colonies bacillary forms of the same nature as are seen in the gelatine colonies of streptococcus scarlatinæ or conglomeratus both before and after passage through a mouse. In consequence of the acquirement of this property, therefore, in addition to their other characters previously described, I can now definitely identify the streptococcus engaged in these three fatal cases of scarlet fever, viz., cases 1, 7, and 8, with streptococcus scarlatinæ or conglomeratus.

Conclusions.—(1) While it is highly probable that the streptococcus recovered most frequently from the scarlatinal cadaver, and not immediately admitting of identification with streptococcus scarlatinæ or conglomeratus, was really in all the eight cadavers a characteristically modified form of that organism; identity can only at present claim to have been definitely established in the case of the streptococcus obtained in three of these eight fatal cases of scarlet fever*.

(2) In these three cases (1, 7, and 8), however, the streptococcus that destroyed the patient, with or without complications, may without doubt be considered identical with the streptococcus scarlatinæ or conglomeratus.

(3) The type of streptococcus scarlatinæ derived from the scarlatinal cadaver, that cannot from its morphological and cultural characters be immediately identified with streptococcus scarlatinæ or conglomeratus, is very virulent for mice.

A point that must also be remembered is that this highly virulent form of streptococcus scarlatinæ was in one of the above three cases, viz., in case 8, obtained from the secretion on the surface of the tonsil, as well as from the blood and tissues. The increase of virulence of streptococcus scarlatinæ therefore takes place in these cases in all probability in that situation.

SECTION III.

THE RELATION of STREPTOCOCCUS SCARLATINÆ to STREPTOCOCCUS PYOGENES.

While the above further information concerning the bacteriology of scarlatina, and in particular the characters and derivatives of streptococcus scarlatinæ or conglomeratus, has been obtained, it has also been my task to carry on a parallel research into the characters of other streptococci. There is no doubt that a leading problem to be settled in the study of the flora of scarlatina is the relation of the streptococci present in an actively pathogenic state in that disease, not only to the specific fever with which they are so intimately and constantly associated, but also to other streptococci, and in particular to that example of the division of streptococcus medius commonly known as the streptococcus pyogenes. I have therefore examined in this connection first the streptococci present in the throat in conditions other than scarlatina, and secondly organisms of this type obtained from the tissues in disease processes of a non-scarlatinal nature. With regard to the streptococci present in throats, examples of these organisms obtained from that source in the following conditions have been investigated:—Normal, tonsillitis, membranous pharyngitis, and diphtheria. I have also recommenced the study of the scarlatinal throat, paying special attention to the characters and pathogenicity of streptococci there present other than streptococcus scarlatinæ. Disease processes, however, in which streptococci are concerned are by no means limited to the throat. The investigation has therefore been extended to streptococci coming from the various localities of the body, where they are to be obtained in disease processes of a non-scarlatinal nature. Owing to the continued kindness cf Dr. Andrewes, who has kept me well supplied with streptococci of this description, quite a large number have now been subjected to examination.

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* It will be remembered that in two of the fatal cases examined the streptococcus obtained could be at once identified with streptococcus scarlatinæ; this organism was recognised therefore in altogether five cases.

STREPTOCOCCI in NON-SCARLATINAL THROATS.

1. *The normal throat.*—On several occasions an examination was made of streptococci obtained from the normal throat. A special search was made for organisms resembling streptococcus scarlatinæ in morphological and cultural characters, and when obtained these were injected into mice. On no occasion were any symptoms of illness produced.

2. *Follicular tonsillitis.*—E. S., male, 18. Slight sore throat. No fever or rash. Follicular tonsillitis present. From the secretion on the tonsil of this case agar plate cultures were made in the usual way. A serum culture was also made. The diphtheria bacillus was not obtained. Staphylococcus albus, and citreus, and many streptococcus colonies were obtained. All the latter that were subcultured gave growth of the same type. This streptococcus made broth turbid and grew in chains of medium length there. In gelatine at 37° C. flocculi appeared, the fluid remaining clear. Milk was not clotted. In growth on agar and gelatine this organism resembled the streptococcus pyogenes. A mouse injected showed slight local suppuration and died on the 27th day. The streptococcus was recovered from its spleen. Although a special search was made in this case then, no streptococcus scarlatinæ was obtained.

3. *Tonsillitis.*—W. J., young adult, male. Headache. Temperature 101°. No rash. Pultaceous deposit on tonsil.

An agar plate showed a few colonies of staphylococcus albus and aureus, and a majority of streptococci. Two kinds of streptococcus were isolated. One of these was of the same type as that obtained in the previous case, and did not clot milk. A mouse injected showed local suppuration and died on the 20th day. The other kind of streptococcus obtained from the tonsil of this case made broth slightly turbid, but showed conglomeration microscopically. A litmus milk subculture showed a strongly acid reaction, and was clotted by the 3rd day. The growth on the surface of gelatine was slower than is usually the case with streptococcus pyogenes. A mouse was injected, but remained quite unaffected. The pathogenic streptococcus in this case, therefore, was of the same type as that obtained in the previous case; while the streptococcus that showed some conglomeration and clotted milk was non-pathogenic as regards the mouse.

4. *Membranous pharyngitis.*—The symptoms of the patient were more severe in this case than in the two preceding ones. Clinically, in fact, the patient from whom the culture was made in this instance appeared to be suffering from diphtheria. A previous culture on serum-agar from a patch of membrane, however, failed to show the diphtheria bacillus, only streptococci being present. The present culture made on the 3rd day of the disease in the same way also shows no diphtheria bacillus. The culture in the present instance contained a large majority of streptococcus and also one colony of staphylococcus. From the condensation fluid of this culture direct from the membrane an agar plate was made. The colonies that developed by the next day appeared to be all of the same type. Several of them were subcultured in broth, and all turned out to be the same organism, which was a streptococcus of the following characters :—

Broth 37° C.—Dense uniform turbidity. The chains are very short, the longest consisting of seven elements. Diplococci are by far the most prominent feature.

Gelatine 37° C.—Dense uniform turbidity. Resembles streptococcus brevis or pneumococcus.

Litmus milk 37° C.—Completely decolorised, one day. Clot, two days.

Agar colonies 37° C.—Grey discs, round or oval. No chains seen on examination with a low power. Resemble streptococcus brevis.

Gelatine 20° C.—Excellent growth of grey colonies ; strongly resembling the growth of streptococcus brevis.

In morphological and cultural respects therefore this streptococcus closely resembled the streptococcus brevis of the normal throat. A mouse injected, however, was dead in one day from acute septicæmia, the organism being recovered from its blood and organs. A careful examination was made but no capsules were seen around the diplococci in the blood of the mouse.

This, therefore, was a variety of streptococcus that was new to me, namely, a very virulent form of streptococcus brevis. Streptococcus scarlatinæ was again absent in this case.

5. *Diphtheria.*—The patient has had scarlet fever four times. On the present occasion, however, an ascitic-agar culture from the throat on the 3rd day of the disease shows numerous colonies of diphtheria bacilli. An agar plate made from the condensation fluid of the ascitic-agar culture showed colonies of staphylococcus in the minority, and of a streptococcus in the majority.

The streptococcus obtained has the following characters :—

Broth 37° C.—Fluid clear. Flocculi and granular flakes are seen adhering to the sides of the tube, and collected at the bottom. Microscopically the streptococcus shows a considerable tendency to conglomeration, but though this character is marked, it is nothing like that of streptococcus scarlatinæ. The chains which are seen are of the *medius* type.

Gelatine 37° C.—Fluid clear. Flocculi throughout and at bottom.

Litmus milk 37° C.—Strongly acid reaction, two days. No clot in one month.

Agar Colonies 37° C.—Streptococcus medius.

Gelatine colonies 20° C.—Typical streptococcus medius. A mouse injected was dead in one day. Pure cultures of the streptococcus were recovered.

In this case of diphtheria therefore, while no streptococcus scarlatinæ was obtained, the streptococcus present with the diphtheria bacillus and staphylococcus aureus, was a specimen of streptococcus medius showing considerable conglomeration and possessed of the highest virulence for a mouse.

Summary of the streptococci present in the non-scarlatinal throats examined.—Streptococci from the *normal* throat have not been found to be virulent for mice. In both cases of *tonsillitis* examined, however, a virulent form of streptococcus medius was present. Although the virulence of this form was not of the highest degree, it was sufficient in both cases to eventually produce death in a mouse. A case of *membranous pharyngitis* in which the diphtheria bacillus was not present, yielded a streptococcus that, while nearly approaching streptococcus brevis in cultural and morphological respects, was found to differ from that organism in being possessed of the highest virulence for mice. A case of *diphtheria* in which the diphtheria bacillus was proved to be present, yielded a streptococcus that, while corresponding to medius (*a*) in cultural and morphological respects, was also found to be possessed of considerable conglomerating tendency in broth. It did not, however, by any means rival S. scarlatinæ in the latter respect. This streptococcus from the diphtheria throat was found to be possessed of the highest virulence for mice. While, therefore, in the above cases streptococci were present in an actively pathogenic condition, no streptococcus was obtained that could be identified with streptococcus scarlatinae or conglomeratus of the scarlatinal throat.

STREPTOCOCCI other than STREPTOCOCCUS SCARLATINÆ PRESENT in the SCARLATINAL THROAT.

Recently two more scarlatinal throats were examined. My purpose was chiefly to test once more my previous results with regard to the bacillus-forming characters of streptococcus scarlatinæ or conglomeratus, but in these two instances I also tested the virulence of other streptococci present. Both cases were mild, uncomplicated, typical scarlatina from the clinical point of view.

(A.) Case 54.—A. R., male, 18. 8th day from date of attack. Patient says he has had more inconvenience from sore throat than from any other symptom, but no lesion is visible there. Cultures gave staphylococcus aureus and citreus, streptococcus medius, streptococcus scarlatinæ, and streptococcus longus.

The streptococcus scarlatinæ obtained from this case is described in the list of these given previously. The streptococcus longus was a variety of that type described in last year's report. The streptococcus medius showed considerable but not excessive conglomeration in broth. It was in other cultural and morphological respects identical with the streptococcus of this class obtained from the diphtheria throat above. A mouse was infected with it and, as in that case, death was produced in one day. On the other hand, a mouse injected with the variety of streptococcus longus obtained in this case remained quite unaffected.

(B.) Case 55.—Male, aged 5. Fifth week since date of attack. No complications. Cultures from this case showed staphylococcus albus and citreus, and streptococcus longus and scarlatinæ. Both the latter were injected into mice. The animal infected with streptococcus longus remained unaffected; that infected with streptococcus scarlatinæ showed local suppuration and died on the ninth day. (*See* above.)

In the first of these two cases therefore (A) an example of the streptococcus medius or pyogenes showing considerable conglomerative faculty in broth, and possessed of the highest virulence for mice was present, together with streptococcus scarlatinæ. Thus virulent streptococcus pyogenes can be obtained from the throat as well as from the aural or nasal discharge of scarlatina. In this particular case also the streptococcus pyogenes present was considerably more virulent than the streptococcus scarlatinæ obtained. In the second case (B), on the other hand, streptococcus scarlatinæ alone of the streptococci present possessed virulence.

These observations, therefore, as far as they go, tend to show that while examples of other virulent streptococci, especially the streptococcus medius or pyogenes, are to be obtained in various diseased conditions of the throat, including scarlatina, the particular organism to which the term streptococcus scarlatinæ or conglomeratus has been restricted is only to be found in the scarlatinal throat. These control-results, therefore, taken together with the further characters of streptococcus scarlatinæ described in this report, go far to support the suggestion of an aetiological relationship between this pathogenic microbe and the disease with which it is so constantly and apparently exclusively associated.

STREPTOCOCCI PRESENT in DISEASE-PROCESSES other than SCARLATINA.

Attention, however, has not been confined to the streptococci concerned in diseases of the throat, but a considerable number of these organisms from cases of suppuration and septicæmia have also been examined. The type which has been found in all the latter instances is the streptococcus medius or pyogenes, an example of which was described in last year's report.

The specimens of the latter type on which the present observations are founded came from the following sources:—Ear discharge of scarlatina, 4; nasal discharge of scarlatina, 3. *Throats:* Scarlatinal tonsil, 1; follicular tonsillitis, 1; tonsillitis, 1;

diphtheria, 1. *General disease-processes other than scarlatinal:* Phlegmon, 1; abscess, 2; bubo, 2; joint suppurations, 2; empyema, 1; pleural effusion (serous) in erysipelas, 1; and in a case of acute pleurisy, 1; peritonitis, 2; meningitis, 2; septicæmia spleens, 2; pyæmia heart's blood, 1: puerperal septicæmia heart's blood, 2. Total, 30 examples of streptococcus medius or pyogenes.

THE CHARACTERS of STREPTOCOCCUS MEDIUS or PYOGENES.

Broth 1 *day* 37° C.—In 19 cases the fluid of the broth remained clear, but in the remaining 11 it became turbid. In last year's report it was stated that in the former case the streptococcus was termed medius (*a*) and in the latter medius (*b*). I have, however, found that the same streptococcus may at one time make broth turbid and at another leave it clear. Turbidity, therefore, is of no particular significance. At the same time two-thirds of the above streptococci, when freshly obtained, left the fluid of the broth clear. The growth occurs as small flocculi or sometimes as granules and flakes scattered throughout the fluid and collected at the bottom of the tube. In either case the growth may be slightly adherent to the side of the tube, and may form a kind of veil there when first taken out of the incubator. The growth, however, soon sinks to the bottom. There is no difficulty in spreading a piece of the growth on a cover-glass, as it does not resist separation. Microscopically the chains are plentiful and of medium length, *i.e.*, intermediate between those formed by streptococcus longus and brevis in this medium. In several cases of streptococcus medius or pyogenes, conglomeration is quite absent in the growth in broth. At the same time conglomeration to a certain extent is not rarely seen in broth cultures of streptococcus medius, and it may be present to a considerable degree. Indeed I have exceptionally seen examples of this type which show conglomeration so well as to approach the streptococcus most frequently obtained from the scarlatinal cadaver in this respect. But I cannot say that I have yet seen either one that quite rivals, or one that exceeds, the latter in conglomerative faculty, and certainly none have been as yet obtained that at all rival streptococcus scarlatinæ or conglomeratus of the scarlatinal throat in mild cases of the disease in the power of coherent conglomeration. The elements are found to be small round cocci, and bacillary forms are rare in broth cultures of the streptococcus medius or pyogenes.

Gelatine 37° C.—The fluid is left clear, and flakes and flocculi are seen throughout and collected at the bottom.

Agar condensation fluid 37° C. 2 *days.*—Either small flocculi or a dusty precipitate are seen collected at the bottom of the small collection of fluid that forms at the foot of an agar culture. I have not yet seen exactly the same dawn of the growth as referred to in the case of agar cultures from the scarlatinal tissues when a pure culture of the streptococcus of the scarlatinal cadaver is obtained. Microscopically streptococcus pyogenes does not as a rule show lace-work arrangement to any great extent in agar condensation fluid; median or short separate chains and small groups are in my experience the commonest. Exceptionally small pieces of lace-work do, however, occur in cultures of pyogenes. While the majority of the elements are coccus-shaped, bacillary forms are occasionally seen. Not unfrequently, however, the latter are absent.

Litmus milk 37° C.—Of the 30 examples of streptococcus medius or pyogenes examined, 28 fail to clot milk. In only two instances was a clot produced, namely, in the instance of a streptococcus from the meningeal pus of a case of septic meningitis, and in one instance by a streptococcus obtained from the spleen of a patient dead from septicæmia. An acid reaction was produced by every one of the above examples of streptococcus pyogenes. It was, however, a slight one in the vast majority by the 3rd day. In both the cases where milk was clotted, the reaction was very strongly acid, a feature I have always hitherto found when any streptococcus clots milk.

Agar colonies 1 *day* 37° C.—The majority of the colonies are round or oval, firm-edged, grey, and slightly granular. Some of them, however, have irregular edges, at which they show a few straggling chains. Impression preparations show that the colonies are often composed of chains fitted so regularly and closely to one another that in Gram-stained specimens the chains are not apparent. If, however, a specimen be stained in the ordinary way, and mounted in water instead of balsam, the chains can be better traced. The great majority of the elements are coccus-shaped, and often all are of this type. Occasionally, however, bacillary forms are seen in impressions of the agar colonies of streptococcus pyogenes, though in my present experience they are not common.

Gelatine colonies 3rd or 10th day 20° C.—The growth appears to be greyish blue, and is not raised. The separate colonies appear in 48 hours as round or oval greyish blue spots. Chains are not in my experience much developed in the growth of streptococcus pyogenes on gelatine. Impression preparations show a mosaic of closely set round or oval cocci of uniform type and not unlike a collection of small shot. Bacillary forms are not seen.

Pathogenicity.—A few of the above examples of streptococcus pyogenes were injected into mice, exactly the same conditions being observed as when testing other streptococci. One of three effects was seen: (1) The animal rapidly succumbs to acute septicæmia in one, two, three, or four days. (2) Better resistance is offered and local suppuration occurs. In the latter case either death does not take place till a longer time, or (3) the mouse recovers. Cultures were made from the organs of all the mice that died after inoculation with streptococcus pyogenes. In the great majority of the cases that organism was recovered. It was always found on re-examining the characters of the streptococcus recovered from the mouse that the morphological and cultural characters were the same as originally. Though a careful watch has been kept, no increase of bacillus-formation has yet been seen in a case of streptococcus pyogenes on recovery from the organs of a mouse.

COMPARISON BETWEEN STREPTOCOCCUS MEDIUS or PYOGENES, and STREPTOCOCCUS SCARLATINÆ or CONGLOMERATUS from the THROATS of MILD CASES of SCARLATINA.

1. *Broth* 37° C. 1 *day*.—The distinctive character of the intensest type of coherent conglomeration displayed by streptococcus scarlatinæ when growing in broth has been found as the result of further experience of streptococcus medius or pyogenes to be maintained. Although specimens of streptococcus pyogenes are found that exhibit considerable conglomeration; none at all rivalling streptococcus scarlatinæ in this matter has yet been obtained. But conglomeration of the highest degree is not exhibited by all examples of streptococcus scarlatinæ as obtained from the scarlatinal throat. These latter types, however, have chain formation so well developed that they are more liable to be confused with streptococcus longus than with streptococcus medius. On the whole, then, the character of the growth in broth of streptococcus scarlatinæ distinguishes it from streptococcus pyogenes completely.

2. *Agar condensation fluid* 37° C. 2 *days*.—The above differences in broth also hold true between the growth of streptococcus scarlatinæ and that of streptococcus pyogenes in this medium.

Litmus milk 37° C.—Streptococcus scarlatinæ often clots milk. Out of 30 examples of streptococcus pyogenes 28 fail to do so. At the same time examples of S. scarlatinæ may fail to clot milk. The test therefore while it distinguishes some examples of S. scarlatinæ, does not distinguish others. It must be remembered, however, that the litmus milk test may occasionally be a very convenient and welcome means of distinguishing bacillus-forming varieties of streptococcus scarlatinæ from B. diphtheriæ and its allies.

Agar 37° 1 *day*.—The growth of streptococcus scarlatinæ is much less profuse than that of S. pyogenes. The colonies of S. scarlatinæ are also quite different from those of S. pyogenes on the same medium. The colonies of S. scarlatinæ are more constricted, develop nodules, and show far better chain-work at places than do the colonies of S. pyogenes. The chain-work which some varieties of S. scarlatinæ exhibit on agar is far in excess of anything that I have seen in the case of S. pyogenes, and even suggests the growth of S. longus in places. Microscopically also bacillary forms occur in the agar colonies of S. scarlatinæ much more profusely than I have yet seen them in the colonies of pure cultures of streptococcus pyogenes. In some cases in fact of S. scarlatinæ, they are in excess of the coccus elements. The distinctions therefore between the agar colonies of S. scarlatinæ and those of S. medius or pyogenes noticed in last year's report, are maintained and increased by further experience.

Gelatine 20° C. *3rd or 10th day.*—A streak culture of S. scarlatinæ grows much slower than a streak culture of typical S. pyogenes. This is especially true of the examples of S. pyogenes obtained from inflamed but non-scarlatinal throats. Examples of S. medius or pyogenes, however, are occasionally seen that grow very feebly on gelatine at 20° C. Hence the rate of growth on gelatine at 20° C., though valuable, is not infallible as a criterion. But the nodulation that occasionally occurs in the older gelatine colonies of S. scarlatinæ is in my present experience never shown by S. pyogenes under the same circumstances. When this character is shown therefore it may be useful as a distinguishing mark. The great difference, however, between the growth on gelatine of streptococcus scarlatinæ and streptococcus pyogenes is in regard to the formation of spindles and bacillary forms. This characteristic is in my present experience never shown by streptococcus pyogenes; and thus it is a peculiarly distinctive feature of streptococcus scarlatinæ. The element of S. pyogenes are much more uniform in size and shape than is the case with S. scarlatinæ.

Pathogenicity.—Streptococcus scarlatinæ has a much lower virulence for mice than streptococcus pyogenes. Four days is the earliest date at which death has been produced in a mouse by S. scarlatinæ or conglomeratus from the scarlatinal tonsil or nares in the mild type of the disease. A capital comparison between the two organisms is afforded by the recent case "54" in which both were isolated from the same tonsil. Equal doses of similar subcultures of each were injected into mice. The example of streptococcus pyogenes killed the mouse in one night, the other animal only showed some local suppuration and was alive 52 days later. This general difference between these two organisms is also supported both by last year's report and by the control observations of the streptococci in non-scarlatinal but diseased throats.

Conclusion.—Coherent conglomeration, chain-formation, and bacillus-formation are some among the many differences that in their aggregate serve to completely distinguish streptococcus scarlatinæ or conglomeratus of the scarlatinal throat in mild cases of that disease, from the streptococcus pyogenes.

COMPARISON between the STREPTOCOCCUS MEDIUS or PYOGENES, and STREPTOCOCCUS SCARLATINÆ or CONGLOMERATUS of the SCARLATINAL THROAT in MILD CASES after PASSAGE through MICE.

In some instances the characters of streptococcus scarlatinæ are very little altered. This is especially true of the examples of this organism recovered from the site of inoculation. The characters of that form of streptococcus, however, that has been most frequently recovered from the blood and organs of mice that succumb to infection with streptococcus scarlatinæ are found to be, as previously noted, somewhat different from those of the original. But at the same time this form of streptococcus scarlatinæ still possesses some of the peculiar features of its parent, and in the case of the growth in the agar condensation fluid, has actually developed a fresh distinguishing character.

Broth 1 *day* 37° C.—The modified form of streptococcus scarlatinæ derived from the mouse generally fails to show coherent conglomeration to anything like the extent of the original. This character therefore that is chiefly relied on in distinguishing S. scarlatinæ from S. pyogenes in broth culture, can in this instance be no longer relied on.

Agar condensation fluid 2 *days* 37° C.—Conglomeration, however, is better seen here, and combined with the development of chains gives rise to the characteristic "lace-work" arrangement of the growth of the modified streptococcus scarlatinæ. I have not yet seen this arrangement occur to anything like the same extent in cultures of the streptococcus pyogenes in the same medium. Bacillary forms are also developed more plentifully by the form of streptococcus scarlatinæ most frequently derived from the mouse, than by the streptococcus pyogenes. The combination of lace-work and bacillus-formation, therefore, tends to distinguish this modified streptococcus scarlatinæ from streptococcus pyogenes.

Litmus milk 37° C.—Both organisms produce most often weak acid, but no clot.

Agar colonies 1 *day* 37° C.—The general appearance of the agar colonies is similar in both cases. In some instances of the modified form of streptococcus scarlatinæ, however, chain-formation is better developed than in the case of pyogenes. On making impression preparations also it is found that bacillary forms occur, to a greater extent, in the colonies of the former than in those of streptococcus pyogenes.

Gelatine colonies 20° C. 3*rd or* 10*th day*.—To the naked eye the appearance of the growth of the two streptococci is similar, except that the modified form of streptococcus scarlatinæ tends to grow more slowly. The chief difference between the two is seen on making impression preparations of the gelatine colonies. Whereas in the case of streptococcus pyogenes these are seen to be entirely composed of round or slightly oval small cocci, in the case of the modified form of streptococcus scarlatinæ these same gelatine colonies show a development of spindle, wedge-shaped, and bacillary elements totally unlike the elements of the former.

Pathogenicity.—The increased virulence which streptococcus scarlatinæ has acquired by passage through the mouse is equal to that possessed by the streptococcus pyogenes.

Summary.—While the growth of this form of streptococcus scarlatinæ most frequently derived from the mice that succumb to infection with that organism, in broth, and in litmus milk, is not easily distinguished from that of streptococcus pyogenes in similar media; and while the growth on the surface of agar is very similar to the eye, and that on the surface of gelatine less distinctive than originally; in spite of all these points of resemblance these two organisms cannot by any means be considered the same. The lace-work arrangement of the growth in agar condensation fluid, and the more plentiful development of bacillary forms both there and in the agar colonies, and particularly the characteristic development of these forms in the gelatine colonies, are facts that distinguish the modified form of streptococcus scarlatinæ from the streptococcus pyogenes. Owing to the increase of virulence, this form of streptococcus scarlatinæ can no longer be distinguished from the streptococcus pyogenes by its effect on mice.

COMPARISON between the STREPTOCOCCUS MEDIUS or PYOGENES, and the STREPTOCOCCUS most frequently obtained from the SCARLATINAL CADAVER in the TEN CASES EXAMINED.

The characters of the streptococcus most frequently recovered from the scarlatinal cadaver have been previously described. They have also been compared with those of streptococcus scarlatinæ or conglomeratus of the scarlatinal throat in mild cases, and also with those of the form of that organism most frequently recovered from the tissues of mice that succumb to it. There still remains, however, to compare the streptococcus most frequently obtained from the scarlatinal cadaver with the streptococcus pyogenes.

Broth 1 *day* 37° C.—The conglomeration displayed by the streptococcus of the scarlatinal cadaver is greatly in advance of that seen in broth cultures of the majority of specimens of streptococcus pyogenes hitherto examined. In some instances, however, of streptococcus pyogenes conglomeration is so well marked as to approach the streptococcus of the scarlatinal cadaver in this respect. Experience up to the present time therefore does not admit of my drawing a definite distinction between the two organisms in regard to conglomeration. At the same time I cannot say that I have yet seen a specimen of streptococcus pyogenes that quite equals the other organism in this respect. Chain-formation also may be more developed in broth by the streptococcus of the scarlatinal cadaver than by the streptococcus pyogenes. This, however, is variable.

Agar condensation fluid 2 *days* 37° C.—I have not yet seen an example of streptococcus pyogenes that as regards the dawn of its growth in this medium corresponds with the streptococcus most frequently recovered from the scarlatinal cadaver. Microscopically, also, lace-work is well seen in many cases of this streptococcus, and the extent to which chains are occasionally developed exceeds anything I have yet seen in the same medium inoculated with streptococcus pyogenes. Bacillary forms in this medium are frequent in the case of the streptococcus from the scarlatinal cadaver, and much less common in the case of streptococcus pyogenes.

Litmus milk 37° C.—28 out of 30 examples of streptococcus pyogenes fail to clot milk, and six out of 41 examples of the streptococcus most frequently obtained from the scarlatinal cadaver clotted milk. The great majority, therefore, in both instances fail to clot milk.

Agar colonies 1 *day* 37° C.—The appearance in the two cases is very similar. The streptococcus from the scarlatinal cadaver, however, may show better chain-work than streptococcus pyogenes. Impression preparations prove that bacillary forms are apt to be more frequent in the case of the former than in the case of streptococcus pyogenes.

Gelatine colonies 20° C. 3*rd or* 10*th day.*—The growth on gelatine is alike in the two cases except that in the case of the streptococcus most frequently obtained from the scarlatinal cadaver the rate of growth is slower. In the case of the streptococcus of the scarlatinal cadaver also I have occasionally seen nodules develop in the gelatine colonies, a feature still to be observed in the case of the streptococcus pyogenes. Impression preparations of the gelatine colonies of the streptococcus most frequently obtained from the scarlatinal cadaver show, when that organism is recently derived from its source, no definite bacillus-formation. At the same time if comparison be made with a similar preparation of the streptococcus pyogenes it will be found that the elements in the latter case are of a more uniform size than in the case of the streptococcus of the scarlatinal cadaver. The irregularity in the size of the elements of the latter, however, may in some cases become increased after cultivation for some time outside the body, so that in three instances now definite bacillus-formation is seen in the gelatine colonies. Another instance in which the same thing occurred was in the case of the streptococcus obtained from the pleural effusion that developed in a case of scarlatina. In the case of this organism the bacillary and spindle-shaped forms that now are seen in impression preparations of the gelatine colonies are extremely characteristic of streptococcus scarlatinæ.

Pathogenicity.—The virulence for mice is similar in both cases.

Summary.—The conglomeration shown by the streptococcus most frequently derived from the scarlatinal cadaver in broth has been seen to be nearly, but not quite, approached by some examples of the streptococcus pyogenes. The "lace-work" developed by the streptococcus of the scarlatinal cadaver in agar condensation fluid is a point of difference from streptococcus pyogenes. The bacillus-formation in the last medium, and in the agar colonies, is also in excess of that yet seen in the case of the streptococcus pyogenes. In three instances of the streptococcus of the scarlatinal cadaver, bacillus-formation on the part of the gelatine colonies was acquired on culture. In the latter three cases therefore, (Nos. 1, 7, and 8) I am now able to definitely identify the streptococcus obtained, with streptococcus scarlatinæ or conglomeratus. With regard to the rest, however, I am at present unable to finally decide. It will be remembered that they were indistinguishable from their companion streptococci, including the streptococcus of the pleural effusion, when first isolated from the body. Again they present some of the same differences from the streptococcus pyogenes as did streptococcus scarlatinæ or conglomeratus of the scarlatinal tonsil after passage through a mouse, especially in regard to "lace-work" and bacillus-formation on agar. In one case also where this form of streptococcus scarlatinæ derived from the mouse was further passed through a guinea-pig, it was found to have undergone a further change, and to be now identical with the streptococcus most frequently obtained from the scarlatinal cadaver. All these facts, therefore, unmistakeably point to the streptococcus most frequently obtained from the scarlatinal cadaver being, in all the cases examined, derived from streptococcus scarlatinæ or conglomeratus of the scarlatinal throat in mild cases of the disease, and not from the streptococcus medius or pyogenes.

SECTION IV.

GENERAL SUMMARY AND CONCLUSIONS.

I.—The Bacteriology of the Tonsil and Fauces in uncomplicated Cases of Scarlatina.

Summary.—Streptococcus scarlatinæ or conglomeratus, the micro-organism which has been described in the last two reports as frequenting the mucous secretion on the surface of the tonsil or fauces in scarlatina, and which has been found in a certain number of cases to persist in this locality up to a period considerably remote from the date of attack, has, as the result of continued study, been found to possess a further morphological characteristic that, in the extent to which it may be developed, forms an additional and important means of distinguishing streptococcus scarlatinæ from other streptococci. In point of fact, the presence of wedge-shaped, spindle-shaped, and rod-shaped elements in the agar and gelatine colonies of pure cultures of streptococcus scarlatinæ may be so prominent in some instances that this characteristic, which increases the distinction of the latter micro-organism from the streptococcus medius or pyogenes, may actually tend to the confusion of streptococcus scarlatinæ with bacillus diphtheriæ or its allies. The latter difficulty, however, vanishes at once on a thorough examination of all the characters of the micro-organism in question.

While this further characteristic has been added, the differential value of the conglomerate and coherent growth of streptococcus scarlatinæ in broth culture, a property that, from the extent to which it may be developed, threatens in some cases to lead to the confusion of this micro-organism with a staphylococcus, and hence was considered to be a peculiarity, has been maintained. Thirty examples of streptococcus medius or pyogenes collected from the various disease-processes in which that organism is concerned, and compared with streptococcus scarlatinæ or conglomeratus, failed to in any way rival that organism in this respect.

The two properties of bacillus-formation and coherent conglomeration therefore in combination, achieve with ease the morphological differentiation of streptococcus scarlatinæ from the 30 representative examples of streptococcus medius or pyogenes with which comparison has been made. These two, however, are not the only respects in which streptococcus scarlatinæ differs from streptococcus pyogenes. The character of the growth and colonies of streptococcus scarlatinæ on agar and gelatine, and the clotting of milk by this organism when effected, are further points of distinction from streptococcus pyogenes.

The virulence for mice of streptococcus scarlatinæ of the scarlatinal tonsil in uncomplicated cases of that disease is inferior to that of many active examples of the streptococcus pyogenes.

While streptococcus scarlatinæ has been shown to be constantly present in the throat of scarlatina, it has not been obtained from the inflamed but non-scarlatinal throats which have been examined. In three of these cases the virulent streptococci present were of the medius or pyogenes type, and in the fourth a virulent form of streptococcus brevis was obtained. But while streptococcus scarlatinæ has not been obtained from the inflamed but non-scarlatinal throat, streptococcus medius or pyogenes in its most virulent state has been obtained from the throat in a recent uncomplicated case of scarlatina. In this last case streptococcus scarlatinæ was also present in the throat, and was found to be much less virulent for a mouse than its companion streptococcus.

Conclusion.—Streptococcus scarlatinæ or conglomeratus as isolated from the throat in uncomplicated cases of scarlatina is an absolutely distinct micro-organism from the streptococcus medius or pyogenes. While the latter may be present in a virulent condition either in the scarlatinal or in the non-scarlatinal but inflamed throat, the presence of streptococcus scarlatinæ is, according to the evidence to hand, exclusively associated with the scarlatinal state.

II. THE EFFECT on STREPTOCOCCUS SCARLATINÆ or CONGLOMERATUS of the SCARLATINAL THROAT in MILD CASES of the DISEASE of PASSAGE through a MOUSE.

Summary.—From the tissues and organs of mice dead after infection with pure cultures of streptococcus scarlatinæ or conglomeratus isolated from the throat in mild cases of scarlatina, two types of this organism are obtainable. In the first it is found that while the cultural and grosser morphological characters are those of streptococcus scarlatinæ, yet microscopically the faculty of bacillus-formation has become so much increased that the elements are now practically entirely bacillary. To this type the term bacillus conglomeratus has been applied. Most often, however, the type recovered from the mice is a streptococcus that, while it preserves the character of occasional bacillus-formation to a marked degree in its colonies on agar and on gelatine, no longer displays the property of coherent conglomeration to the same extent as previously in broth. In the condensation fluid of an agar culture, however, this streptococcus exhibits a combination of conglomeration and chain-formation that results in a peculiar arrangement of the growth. This arrangement has, for want of a better term, been called "lace-work," and is, according to my present experience, neither exhibited to the same extent, nor quite in the same manner, by streptococcus medius or pyogenes. Bacillary forms are also, as a rule, well seen in the lace-work growth in 48 hours.

The character of its growth in agar condensation fluid, and the extent to which this streptococcus exhibits bacillary forms, particularly the fact that the latter are well developed in its colonies on the surface of gelatine at 20° C., are points that serve to distinguish this modified form of streptococcus scarlatinæ from the streptococcus pyogenes. Except in these particulars, however, it is not easy to distinguish between them.

The experiments at present to hand indicate that of these two types of streptococcus scarlatinæ derived from mice that succumb to infection with that organism, the entirely bacillary form is the less virulent of the two. On the other hand the mouse streptococcus may possess considerably increased virulence. With regard to the effect on its morphological and cultural characters of further passage through animals, the following are the result of some experiments in this direction :—On one occasion a mouse and two guinea-pigs were inoculated with an example of this streptococcus. The mouse and one of the guinea-pigs were dead in 24 hours. Pure cultures of the streptococcus were obtained from the heart's blood of each animal. On examining the morphological and cultural characters of each heart's blood culture in the usual way, it was found that the characters were identical with those of the organism injected in the case of the culture from the mouse. The culture derived from the heart's blood of the guinea-pig, however, now had regained the power of coherent conglomeration in broth culture, leaving the fluid quite clear. Moreover, the gelatine colonies now did not show bacillary forms when examined. In these and in other respects this streptococcus was now found to be identical with that most frequently recovered from the blood and organs of persons who succumb to scarlet fever. Unfortunately this culture was not kept up, or it would have been interesting to see if, on continued culture, it regained the power of bacillus-formation in its gelatine colonies, as has been the case in the streptococcus from the pleural effusion, and also in three out of five instances of the streptococcus most frequently obtained from the scarlatinal cadaver.

Conclusion.—Streptococcus scarlatinæ or conglomeratus of the scarlatinal tonsil in uncomplicated cases of that disease, by passage through a mouse undergoes modification in one of two directions. Either its morphological peculiarities are increased, particularly in the matter of bacillus-formation, with the result that an entirely bacillary form, bacillus conglomeratus, is obtained, or, more frequently, its morphological and cultural peculiarities are diminished, particularly in the matter of conglomeration ; but sufficient of them remain to distinguish it from the streptococcus pyogenes. In the latter instance, *i.e.*, in the case of the streptococcus most frequently recovered from mice that succumb to infection with streptococcus scarlatinæ, virulence may be increased. In one instance in which the latter form was passed through a guinea-pig, it was found to have undergone still further modification, and now to coincide in morphological and cultural characters with the streptococcus most frequently recovered from the scarlatinal cadaver. In this case, therefore, the descent of the latter organism from streptococcus scarlatinæ or conglomeratus of the scarlatinal tonsil in uncomplicated and mild cases of the disease was demonstrated. As this last was but a single experiment, however, it can only be taken for what it is worth until further evidence is forthcoming.

III. The Bacteriological Examination of a Complication during Life, viz., of a Serous Effusion in the Pleural Cavity that occurred in the Course of Scarlatina.

A pure culture of streptococcus was obtained from this pleural effusion, the removal of which was necessary in the interest of the patient. The culture was kindly handed on to me by Dr. Hopwood. This micro-organism when it first came under observation was found to be identical with the streptococcus most frequently recovered from the scarlatinal cadaver; chain-formation, conglomeration, and bacillus-formation in the agar colonies and in the agar condensation fluid being particularly prominent features. In virulence also it was similar to that organism. When freshly obtained, this streptococcus showed no definite bacillus-formation in its colonies on the surface of gelatine at 20° C. After having been kept in culture for a year, however, this property has been acquired, and at the present time capital spindle and bacillary forms are seen in impression preparations of the gelatine colonies of this streptococcus. From these characters, and especially from the last one, I am now able to definitely identify this organism with streptococcus scarlatinæ or conglomeratus.

Conclusion.—Streptococcus scarlatinæ can penetrate the system in the course of scarlatina and be obtained in pure culture from a serous exudation occurring as a complication of the disease. Although the faculty of bacillus-formation in its gelatine colonies is found to have become suppressed when this micro-organism is recently obtained from such serous fluid, it can nevertheless be recovered after culture for some time outside the body.

IV. THE STREPTOCOCCI PRESENT in the BLOOD and TISSUES after DEATH from SCARLATINA.

In the first place microscopical examination of the blood and tissues of fatal cases of scarlatina revealed one organism only, namely, streptococcus. This organism was wonderfully abundant in the heart's blood of some cases. Secondly, the heart's blood of the scarlatinal cadaver is virulent for mice in proportion to the amount of streptococcus that it contains. When this organism is present only in small numbers, and when it is absent, the blood is apparently quite harmless to mice even though a larger amount be injected than was sufficient to produce death in the other circumstances. Thus there is no evidence whatever of any other pathogenic factor in the heart's blood of the scarlatinal cadaver than is shown by the culture-method. Cultures then have been found to bear out and extend the conclusion arrived at by the other procedures. Anaerobic cultures made on several occasions from the heart's blood of the scarlatinal cadaver yielded no further results than aerobic. Aerobic cultures were made from altogether 56 sources in the 10 fatal cases of scarlatina examined. Forty-five of these cultures yielded streptococcus, on 26 occasions in absolutely pure culture, and on the remaining 18 occasions as a rule in an overwhelming majority. Ten out of these 45 streptococci clotted litmus-milk, but the rest only produced an acid reaction in that medium.

The streptococci obtained from the scarlatinal cadaver have been considered according as they do or do not admit of immediate identification with streptococcus scarlatinæ or conglomeratus.

(*a.*) Streptococci from the scarlatinal cadaver that admit of immediate identification with streptococcus scarlatinæ or conglomeratus.

Out of 10 streptococci that clotted milk I was able to identify four at once with the streptococcus scarlatinæ or conglomeratus previously obtained on so many occasions from the throat in uncomplicated cases of scarlatina. These four could be at once identified with streptococcus scarlatinæ, because of their morphological and cultured characters which were typical of that organism. Their origin was from case IV. kidney (pure culture), and blood (mixed culture); and from case IX. tonsil (mixed), and cervical gland (pure culture). But while the morphological and cultured characters of these four streptococci were so characteristic of streptococcus scarlatinæ, it was found by testing them on mice that they possessed little or no virulence for these animals. In the first two instances apparently no illness was produced, while the latter two streptococci produced a transient suppuration which rapidly healed up.

Conclusion.—In four instances when a streptococcus was recovered from the scarlatinal cadaver having the morphological and cultural characteristics of streptococcus scarlatinæ very prominently developed, it was found to possess little virulence for mice. This type was only present in two cases.

(*b*.) Streptococci from the scarlatinal cadaver that do not admit of immediate identification with streptococcus scarlatinæ or conglomeratus.

In the remaining 41 instances, however, where a streptococcus was obtained from a locality in the scarlatinal cadaver, the morphological and cultural characters did not admit of immediate identification with streptococous scarlatinæ or conglomeratus of the scarlatinal throat in the mild type of this disease. The reason why this—the streptococcus most frequently obtained from the scarlatinal cadaver—could not be immediately identified with streptococcus scarlatinæ was not because it did not resemble that organism in some ways, but because the morphological and cultural characters, and also the virulence for mice when this was tested, were found to be less different from the same characters of some examples of the streptococcus medius or pyogenes, than in the case of typical streptococcus scarlatinæ or conglomeratus obtained from the throat in mild cases of this disease.

The streptococcus now under consideration was obtained from 41 sources in the 10 cases examined. In all instances where a streptococcus was detected in the heart's blood it was of this type. In two cases this organism was also obtained from the surface of the tonsil of the scarlatinal cavader. Only six out of these 41 streptococci clotted milk.

The morphological and cultural characters of this streptococcus have been described at some length, and compared (1) with those of streptococcus scarlatinæ, and (2) with those of 30 examples of the streptococcus pyogenes examined in this connection. It was shown that the points in which the streptococcus most frequently obtained from the scarlatinal cadaver was unlike the streptococcus pyogenes were in great part of the same nature as those in which the streptococcus most frequently recovered from the bodies of mice that succumb to infection with streptococcus scarlatinæ or conglomeratus obtained from the throat in mild cases of scarlatina differed from the streptococcus pyogenes. On the other hand, the points of resemblance between these two streptococci (viz., the mouse streptococcus scarlatinæ and the streptococcus of the scarlatinal cadaver) and the streptococcus pyogenes were very similar in both cases, and it cannot be denied that without previous detailed experience of streptococci in general, and of streptococcus scarlatinæ in particular, it is no easy matter to distinguish either of these two organisms from selected specimens of the streptococcus pyogenes. By making a thorough examination of *all* the morphological and cultural characters of each of these three streptococci, however, it becomes plain that both the streptococcus most frequently recovered from the mice that succumb to infection with streptococcus scarlatinæ or conglomeratus, and the streptococcus most frequently recovered from the blood and tissues of persons who succumb to scarlet fever, do differ from the streptococcus pyogenes, and also that some of the points of difference are the same in both instances.

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It was seen in the case of the streptococcus most frequently recovered from the bodies of mice that succumb to infection with streptococcus scarlatinæ, that while it had lost some of the grosser distinctive characters of streptococcus scarlatinæ,—as instanced in the growth in broth, in the grosser appearance of the growth on agar and on gelatine, in litmus milk, and also in being possessed of increased virulence for mice,—at the same time the arrangement of the growth in agar condensation fluid, and the prominent bacillus-formation seen in impression preparations of the agar and especially—for this is a feature I have never yet seen in an example of streptococcus pyogenes—of the gelatine colonies, were characters sufficient to readily distinguish that organism from the streptococcus pyogenes. On the other hand, while the grosser appearances of the colonies on agar and gelatine, the non-production of a clot in litmus milk, and the marked virulence for mice, were characters in which the streptococcus most frequently derived from the scarlatinal cadaver approached the streptococcus pyogenes, it was found that the growth in broth showed conspicuous, if not distinctive, conglomeration, the arrangement of the growth in agar condensation fluid showed the same differences from streptococcus pyogenes as did the modified form of streptococcus scarlatinæ, and the growth either on the surface of agar or in the condensation fluid of the same medium showed marked bacillus-formation. At the same time impression preparations of the gelatine colonies, while they did not show definite bacillus-formation, showed more irregularity with regard to the size and shape of the elements than in the case of the gelatine colonies of streptococcus pyogenes.

While, therefore, the streptococcus most frequently obtained from the scarlatinal cadaver did not show the same marked difference from the streptococcus pyogenes in respect to impressions of its gelatine colonies, it showed more of the characteristic growth of streptococcus scarlatinæ or conglomeratus of the scarlatinal tonsil in mild cases in broth than did the form of that same organism most frequently obtained by passing it through a mouse.

The question, then, of the exact relationship of this, the streptococcus most frequently recovered from the scarlatinal cadaver, to the streptococcus scarlatinæ or conglomeratus was a matter of no little difficulty. While it seemed very probable that it was a modified form of that organism, it could not be claimed that absolute demonstration of this relationship had been obtained.

On considering previous results, however, it was recollected that on one occasion when the streptococcus most frequently recovered from the tissues of mice that succumb to infection with streptococcus scarlatinæ or conglomeratus was injected into a guinea-pig, and the animal died in one day, the streptococcus recovered from that animal's heart's blood was now found to exactly coincide in morphological and cultural respects with the streptococcus most frequently recovered from the scarlatinal cadaver. This fact, therefore, materially strengthened the probability of the descent of the streptococcus most frequently found in the scarlatinal cadaver from streptococcus scarlatinæ or conglomeratus of the tonsil in mild cases.

Here, then, the matter rested until it was discovered, in revising the whole subject previous to making the present report, that the streptococcus obtained by Dr. Hopwood from the pleural effusion that developed in the course of an attack of scarlatina, and which had been identical with the streptococcus most frequently recovered from the scarlatinal cadaver in all its characters, had now, as the result of a year's continued culture outside the body, acquired the property of bacillus-formation in its gelatine colonies. I was, therefore, now able to definitely identify this streptococcus with streptococcus scarlatinæ or conglomeratus of the scarlatinal throat in mild uncomplicated cases of scarlatina.

It was, therefore, determined to test again in this matter the gelatine colonies of the examples still in stock of the streptococcus most frequently recovered from the scarlatinal cadaver. Unfortunately, it had not been possible to keep up all the examples of this organism obtained from the scarlatinal cadaver. I had, however, representative specimens of it from five cases still alive. The cultures were:—From case I., cervical gland; case II., cervical gland and heart's blood; case VI., heart's blood; case VII., heart's blood; and case VIII., spleen. The streptococcus from cases I. and VI. had been kept growing in culture for altogether a year, and in the case of the streptococcus from cases II., VII., and VIII., for six months. The result of impression preparations of the gelatine colonies of these five examples of the streptococcus most frequently obtained from the scarlatinal cadaver has been that in the case of the streptococci from cases II. and VI., although irregularity in the size of the elements is marked, no definite bacillary forms are yet to be seen. On the other hand, the streptococci from cases I., VII., and VIII. now show bacillary forms in their gelatine colonies which are in this respect identical with those of two examples of the streptococcus most frequently recovered from the tissues of mice that succumb to infection with streptococcus scarlatinæ examined at the same time.

By reason of the development of this additional characteristic, therefore, I am now able to definitely identify these three examples of the streptococcus most frequently obtained from the blood and tissues of the scarlatinal cadaver with the streptococcus scarlatinæ or conglomeratus obtained so frequently from the scarlatinal throat in mild cases of that disease.

Conclusion.—While it is highly probable that this, the streptococcus most frequently obtained from the scarlatinal cadaver, is in all cases a modified form of streptococcus scarlatinæ or conglomeratus, the identity can only claim to have been fully established in the case of the streptococcus obtained from three out of the eight cases in which this organism was the supreme bacteriological feature. One of these three cases, viz., case I., was clinically a remarkably pure case of scarlatina. The other two cases, viz., VII. and VIII., were clinically of the "septic" type, but bacteriologically the septic symptoms were undoubtedly in great part due to this modified form of streptococcus scarlatinæ or conglomeratus.

Further, on comparing together the two types of streptococcus scarlatinæ obtained from the scarlatinal cadaver, it is seen that (1) the type that preserves all the morphological and cultural peculiarities of that organism so prominently that it can be at once identified with streptococcus scarlatinæ or conglomeratus has very little virulence for mice; and (2) that, on the other hand, the type of this organism, which has become so modified in those cultural and morphological peculiarities that are characteristic of streptococcus scarlatinæ or conglomeratus that it may easily be confused with the streptococcus pyogenes, is extremely virulent for mice. In short, streptococcus scarlatinæ either preserves its cultural and morphological peculiarities at the expense of its virulence for mice, or increases the latter faculty at the expense of its morphological and cultural individuality. In the last case however, sufficient of its characters still survive to achieve its distinction from streptococcus pyogenes if only a careful examination of all its characters is made.

So much then for the bacteriology of the scarlatinal cadaver. If, however, the last conclusion is compared with a previous one arrived at as the result of the bacteriological examination of the bodies of mice dead after infection with streptococcus scarlatinæ or conglomeratus, it will be seen that something of the same kind was observed there also. In particular it was noted that the virulence for mice of streptococcus scarlatinæ was increased at the expense of its morphological and cultural peculiarities, but in that case also sufficient of the latter remained to achieve its complete differentiation from the streptococcus pyogenes.

It appears, therefore, that much the same modification in the characters of this organism is brought about either when a mouse succumbs to infection with a pure culture of streptococcus scarlatinæ which has been isolated from the throat of a mild case of scarlatina, or when the disease scarlatina in the human subject runs to a fatal issue. The mouse may or may not show local suppuration, the scarlatina patient may or may not undergo suppuration in the region of the tonsil or pharynx. In either case the neighbouring lymphatic glands are enlarged and contain the micro-organism, and the fatal result appears to be most often due to the poisonous activity of streptococcus scarlatinæ in the blood and organs of its host.

GENERAL CONCLUSIONS.

The results of the investigation of the bacteriology of scarlatina which I have made during the past two years have been therefore as follows:—

1. Streptococcus scarlatinæ or conglomeratus is a special pathogenic micro-organism distinct from streptococcus pyogenes on the one hand and bacillus diphtheriæ on the other.
2. It occurs constantly in the mucous secretion on the surface of the tonsil or fauces in scarlatina and may persist there in some cases up to a period considerably remote from the date of attack.

3. It has not been found in four inflamed but non-scarlatinal throats examined for it, but on the contrary other virulent streptococci were present in these cases.

4. It may be present in the nasal discharge of scarlatina. It has not as yet, however, been detected in the aural discharge of that disease.

5. It can penetrate the system and be obtained in pure culture from a serous effusion occurring as a complication in the course of scarlatina.

6. It may be present in the blood and tissues of fatal cases of scarlatina, and may not infrequently be obtained in pure culture from thence.

7. The characters of streptococcus scarlatinæ as isolated from the tonsil of a mild but typical case of scarlatina are apt to undergo modification when a mouse dies from infection with it; and similar modification is found in the case of streptococcus obtained when a patient succumbs to scarlatinal infection. In each instance this modification generally comprises increase of virulence accompanied by diminution of those morphological and cultural characteristics that distinguish streptococcus scarlatinæ from the streptococcus pyogenes, though close examination shows that sufficient differences survive to still permit differentiation of this streptococcus from streptococcus pyogenes.

The evidence, therefore, in these further investigations of the bacteriology of scarlatina has had the consistent result of supporting the contention of Dr. Klein, arrived at by him as the outcome of a series of investigations originated by the Hendon outbreak of scarlatina, that streptococcus scarlatinæ was both a distinct organism from the streptococcus pyogenes, and also that it was causally related to scarlatina. The further characters of streptococcus scarlatinæ or conglomeratus described in the present report, the result of a bacteriological investigation of 10 fatal examples of scarlatina, and of a comparison between streptococcus scarlatinæ and 30 specimens of streptococcus pyogenes, emphatically support the view that streptococcus scarlatinæ or conglomeratus is the specialised* and essential agent of that specific infection known as scarlatina or scarlet fever.

In conclusion, I wish to record my appreciation of the great care and skill with which Mr. Albert Norman has photographed my preparations.

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* How far streptococcus scarlatinæ merits the epithet 'specific' is a matter for future investigation to decide. The term is, for the present, better avoided.

APP. B, No. 2.

On the Bacteriology of Scarlatina; by Dr. Gordon.

ADDENDA.

I. *Observations of Baginsky and Sommerfeld.*

While this report is in the press, the results of some important observations on the bacteriology of scarlatina have been published in the *Berliner Klinische Wochenschrift*, Nos. 27 and 28, July 2 and 9, 1900. The authors of the paper are Professor A. Baginsky and Dr. P. Sommerfeld, and the following is an outline of its contents :—

Reference is first made to a former research by Baginsky on the subject of the bacteriology of diphtheria, in which he found that in cases where, in the course of diphtheria, scarlatina manifests itself as a new infection, repeated bacteriological examination of the throat revealed the presence no longer of diphtheria bacilli, but the cultures contained only cocci. The cocci were apparently chiefly streptococci, for it is next observed that the constant presence of these streptococci in the scarlatinal angina led Baginsky to ascribe to them an aetiological relationship towards the scarlatinal process.

I.—The present research commenced with the investigation of the pharyngeal mucus in cases of scarlatina. Microscopical examination of preparations made directly with this material, and supplemented in a proportion of the cases by cultures, was made in 363 cases. In 336 only cocci, chiefly streptococci, were found to be present. In 22, which were complicated by diphtheria, the Klebs-Loeffler bacillus was present with streptococci. In five cases, besides cocci there were other bacteria. In 62 cases, in which cultures were made from the pharyngeal mucus on Loeffler's blood-serum, the following results were obtained :—In four cases streptococci appeared in pure culture; 29 cases gave streptococci and staphylococci; and 29 cases gave streptococci mixed with other cocci (diplo- and pneumo-cocci) and other organisms, such as leptothrix and yeast, but never diphtheria bacilli.

II.—Examination of the blood and spinal fluid during life. From spinal fluid obtained from a case of scarlatina in which lumbar puncture was performed with a view to relieving the coma and convulsions from which the patient was suffering, and from blood obtained from the same case by venesection made for the relief of dyspnoea, cultures were made. In both instances pure cultures of streptococcus were obtained.

III.—Autopsies. A bacteriological examination was made in 42 fatal cases of scarlatina. The cases were divided into two groups: (A) Those in which the course of the disease was so acute and progressive that death rapidly ensued—hence secondary affections could not have developed and were actually never detected. Eight cases of this type of scarlatina were examined. They had succumbed in an average of 2–5 days from the onset of the first clinical signs; two cases having lasted for only two days, and two for three, four, and five days respectively. (B) Those in which the course of the disease was less progressive and "secondary" affections were present. The bacteriological examination was made in most cases 2–3 hours after death. Cultures were made from the heart's blood, bone-marrow (tibia generally), and, in the majority of cases, from the lungs, spleen, kidney, liver, bronchial and mesenteric glands, and, lastly, from the gall-bladder. Broth cultures were made in the first place and incubated at 37° C. From them agar plates were afterwards made.

The result was that in all the cases examined, both of the slow and the rapid type clinically, a micro-organism was invariably detected which is to be regarded as a streptococcus. This micro-organism was obtained in pure culture without exception in all the cases which were examined soon after death. Pure cultures were also invariably obtained from the heart's blood and bone-marrow on all occasions when these were examined. The virulence of the streptococcus obtained in the above cases was tested on guinea-pigs, white mice, and rabbits, and was found to vary within wide limits. In some cases the streptococci were very virulent, and in others apparently harmless. The virulence could be increased by passage from animal to animal. There did not seem to be any relation between the degree of virulence of the streptococcus and the clinical course of the disease. In the case of the virulent streptococci a broth culture from which the organisms had been removed by filtration was found to possess powerful *toxic* properties. All agglutination experiments, of which many were made, proved negative.

Concerning the morphological and cultural characters of the streptococci obtained, the authors remark that considerable variation was seen in respect to the length of the chains, which might either be limited to three or four individuals, or might extend up to 50 or more. The morphology appeared to be dependent to a considerable extent on the culture-medium, according to the nature of which longer or shorter chains and diplo- or streptococcus forms might prevail. Staining reaction:—the cocci obtained could be stained with all the aniline colours, *and if stained by Gram's method, they retained permanently—even after prolonged action of iodine upon them—the violet colour of gentian violet.* In ordinary broth the fluid remained as a rule clear, and a thick, heavy, adherent precipitate was formed; occasionally, however, the broth was made turbid. The coccus in question coagulates milk at 37° C, and produces acid. It grew on agar in small, round, slightly yellowish brown colonies, with a very finely punctuated, but not quite regular, border. It grew very slowly on gelatine at 18° C. They state that, on the whole, the coccus they thus cultivated exhibited, both as regards growth and appearance, all the characters of the familiar varieties of streptococcus as a class. No morphological or cultural characters were detected by which it might be specially differentiated.

In discussing whether these streptococci are causally related to scarlatina, or whether they should be looked upon as a merely secondary infection, the authors consider that many points are strongly in favour of their being causally associated with the production of scarlatina. In support of this contention they refer particularly to the fact that in all the fatal cases examined the streptococci were invariably obtained from both the heart's blood and bone marrow, and were, moreover, obtained in pure culture in those cases which were examined soon after death. Again, neither the case in which the streptococci were demonstrated during life in the blood and spinal fluid, nor seven of the 42 fatal cases in which the presence of the same streptococci was proved after death, presented any of the so-called "secondary" manifestations. Further, they maintain that the proved high virulence of the streptococci, and their well known aetiological relationship to morbid conditions of a septic character, were strong evidence of their being intimately concerned in the actual causation of the scarlatinal process.

The paper ends with the following conclusions:—

1. In all cases of scarlatinal angina streptococci are to be found. They occur occasionally in pure culture, though frequently they are accompanied by other cocci. In the latter case they are always present in greater numbers than the other cocci.

2. In all the cases of scarlatina (42) which were bacteriologically examined after death, the presence of streptococci could be demonstrated in the blood as well as in all the internal organs and the bone-marrow. Accordingly the conclusion is to be drawn that the streptococci are constantly present in all cases of scarlatina.

3. The streptococci exhibit different degrees of virulence, and the latter may be increased by passage through animals.

4. The streptococci impart to the artificial nutrient medium in which they are grown certain toxic properties.

5. By means of the usual culture methods no specific properties could be detected in them, but the same rule applies to other streptococci associated with diseases other than scarlatina.

6. The constant presence of the streptococcus in these cases which died in consequence of scarlet fever renders it an important factor in the production of the scarlatinal process.

7. All the clinical manifestations of scarlet fever may be explained by the presence of this streptococcus in the internal organs (infection), and by the poisonous action of its metabolic products (toxicity).

Comments.—The constant and intimate association of streptococcus with scarlatina is demonstrated in this paper in a very conclusive manner. The experience of Baginsky and Sommerfeld, therefore, corroborates my own in this respect. The demonstration of the presence of this organism in the eight rapidly fatal cases that showed none of the so-called "secondary" signs, disposes of the theory that streptococcus can only be secondary or accidental in scarlatina. In this connection it should be also noted that the first autopsy described in my report was an example of this quickly fatal type of scarlatina. The wide variation in virulence of the streptococci obtained by them from the scarlatinal cadaver is also in accordance with my own observations. Their demonstration of the production of toxin by this streptococcus is extremely important, as also are their negative results with agglutination experiments. The conclusion of Baginsky and Sommerfeld as to the causal relationship between this streptococcus and the scarlatinal process with which it is so invariably associated is compatible with that advanced previously by Dr. Klein and which also my own results support.

The inability of Baginsky and Sommerfeld to detect any peculiar characteristics of the streptococcus (that is, properties distinguishing it from S. pyogenes) by the usual culture methods will be readily understood by anyone who reads my own report, and remembers that (1) the isolation of streptococcus scarlatinæ has always been effected by me on agar, *not* on blood-serum (this is particularly important in reference to the investigation of the characters of streptococcus scarlatinæ of the tonsil in mild cases of scarlatina); and (2) that the differential appearances and properties characteristic of this organism (such as bacillus formation and lacework formation, and the coherency of the growth in broth), their significance, and their relation to the virulence of streptococcus scarlatinæ, are, to the best of my knowledge, described and illustrated on the present occasion for the first time.

II. *Observations of Class.*

In the *Chicago Medical Recorder* for May, 1889, appeared an article by Dr. W. J. Class, in which he described an organism that he considers to be the cause of scarlet-fever. The culture medium which he employed for the isolation of this organism consisted of glycerin agar mixed with 5 per cent. of garden earth. By using this medium he obtained, he stated, from the scales of about 30 cases of typical scarlatina, from scarlatinal angina, and from angina occurring in persons exposed to scarlatinal infection, but in whom no eruption occurred, an organism the characters of which are described by him as follows:—A diplococcus resembling a very large gonococcus. Usually, unless in spreading the culture on the slide it is rubbed very hard, these cocci occur in bunches of from 10 to 50, which is due to the large amount of gelatinous inter-cellular substance by which they are united. Streptococcus forms are occasionally, though rarely, met with, as also are single cocci. It is destained by Gram's method, though not to the same extent as the gonococcus, a larger variety of the coccus holding the stain somewhat better than a smaller variety. The glutinous nature of the material of which the colonies on earth-agar are composed is also remarked. With regard to the growth on other media, the following statements are made:—"On agar-agar and glycerin-agar there is no growth. On gelatin the result is also negative. Bouillon is not clouded by the germ, and it apparently does not multiply in this medium." On blood-serum there is growth, but it is much more meagre than on earth agar. Milk does not appear to be affected by the diplococcus, although that organism apparently multiplies in it. Pathogenesis: Rabbits and guinea-pigs were inoculated without producing the slightest results. Other animals, however, were being experimented with, and the results would be reported later.

From the above description it appeared to me at the time that Class's micro organism must be quite different from streptococcus scarlatinæ, which grows on agar, glycerin-agar, gelatine, and in broth, often clots milk, and stains by Gram's method. The assertion that Class's diplococcus was, as claimed, the cause of scarlatina also appeared to be without justification, no pathogenesis having been at that time demonstrated.

In the *Lancet*, September 29th, 1900, however, Class, in an article on the etiology of scarlatina, claims that the micro-organism described above is identical with the streptococcus described by Baginsky and Sommerfeld. At the same time he brings forward further evidence of its being causally related to scarlatina, stating among other things that it produces a disease bearing a strong resemblance to scarlatina in white swine. Class in this article does not take into account the definite statements of Baginsky and Sommerfeld that their streptococcus stained by Gram's method, that it grew on media which he had previously expressly stated his organism not to grow upon, that it clotted milk, and also the fact that they were unable to distinguish it from other streptococci.

The further details, however, of his micro-organism that Class gives in this recent communication, particularly the fact that he now states it to have been obtianed from the blood in scarlet-fever, and also often from the throat, and especially the pleomorphic characters of the coccus in culture (on which point both Baginsky and Sommerfeld and Class agree) render it highly probable that the diplococcus scarlatinæ of Class is after all streptococcus scarlatinæ under another name. From his remark, moreover, concerning the glutinous texture of the colonies on earth-agar, it is clear that Class's organism can exhibit coherency. The fact that Class found the coccus in the blood as diplococci and in short chains is by no means inconsistent with its being a streptococcus, for streptococci other than streptococcus scarlatinæ may do this. Nor should it be forgotten that the tendency of streptococcus scarlatinæ to occur in the tissues of experimental animals, and also in cultures, in the form of diplococci and short chains was demonstrated long since by Dr. Klein. (*See* Report to the Local Government Board, 1886–7, "On the Etiology of Scarlatina," plates i., xv., xvi., etc.)

The wide discrepancies in the descriptions of the morphological and cultural characters of the coccus given by Class and by Baginsky and Sommerfeld respectively are, I venture to suggest, explained to some extent by my report. Class, in fact, appears to have worked in great part at the scarlatinal throat during life, Baginsky and Sommerfeld at autopsies. I have shown above that the morphological and cultural individuality of streptococcus scarlatinæ is generally more obvious under the former than under the latter conditions. Hence Class would not realise the danger of confusing this organism with other streptococci, while, on the other hand, Baginsky and Sommerfeld would not be able to distinguish it from them.

Finally, I have been unable to find any evidence that either Class or Baginsky and Sommerfeld examined the colonies on agar and on gelatine by means of impression preparations, or that they observed the growth in the condensation-fluid of agar or of blood-serum cultures. That the evidence obtained by these procedures, however, is of no little importance has been shown in the course of my report.

No. 3.

App. B, No. 3.

On the Value of Examination of Water for Streptococci and Staphylococci with a view to detection of its Recent Contamination with Animal Organic Matter; by Dr. Houston.

ON THE VALUE OF EXAMINATION OF WATER for STREPTOCOCCI and STAPHYLOCOCCI with a view to detection of its RECENT CONTAMINATION with ANIMAL ORGANIC MATTER;

by Dr. A. C. HOUSTON.

In a note in the last Annual Report of the Medical Officer (1898-99, Appendix B, No. 8) I recorded some preliminary observations upon the significance of detecting the presence of staphylococci and streptococci in drinking-water.

Therein I pointed out that in early attempts to utilise bacteriology to detect impurities of animal origin in drinking-water, reliance was almost wholly placed upon mere enumeration of micro-organisms without regard to species, but that since it has come to be understood that the indications afforded by enumeration of this sort are very far from certain, increased attention has been given to tests for the detection in drinking-water of microbes of particular species which are known to have intimate relation with organic matters of animal outcome.

Since the significance of bacillus coli has been established by Theobald Smith in America, and by Klein in this country, examination of water for this bacillus has come to be largely practised. And a further test of great value is now available, namely, search for spores of bacillus enteritidis sporogenes.

By way of illustration of the contrast in respect of these two microbes between pure water and a material such as sewage which is highly contaminated with animal organic matter, I give the following table:—

Pure Water.		*Crude Sewage.*	
B. coli (or closely allied forms):—	Spores of B. enteritidis sporogenes (Klein):—	B. coli (or closely allied forms):—	Spores of B. enteritidis sporogenes (Klein):—
Altogether absent or present in insignificant proportion.	Absent from as much, it may be, as 500 cc. or more.	At least 100,000 per cc.	100—1,000 per cc.

The significance of this contrast in regard of drinking-water is greater in view of the evidence that I have elsewhere given that both B. coli and B. enteritidis sporogenes are absent, or present in comparatively trifling amount, in virgin soils. Water which has been in contact with surface soil will not contain either of these microbes in notable amount if the soil has not been contaminated by animal organic matter.

On the Value of Examination of Water for Streptococci and Staphylococci with a view to detection of its Recent Contamination with Animal Organic Matter; by Dr. Houston.

In utilising B. coli and B. enteritidis sporogenes as tests of the purity of a water, however, difficulty commonly arises in deciding whether their presence necessarily indicates that the contamination has been recent, and so is especially dangerous. I have shown that, in soil, the presence of spores of B. enteritidis sporogenes in excessive amount is inconclusive in this sense: contamination indicated by this microbe may have been recent, or it may have taken place months or even years previously. And although bacillus coli, when present in excessive amount, indicates comparatively recent contamination, the interval may yet have been an affair of weeks or months. It seemed, then, desirable to search for another bacterial test, which should affirm that organic matter of animal outcome had quite recently, and only quite recently, gained access to the water. While negative response to such a test might have little value as an indication that a water was safe for drinking purposes, positive response would be conclusive of danger.

As to streptococci and staphylococci in this relation, I stated last year :—

> "In studying the bacteriology of polluted soils, of crude sewage and sewage effluents, and of impure waters, I have endeavoured to find some organism, or class of micro-organism, which might be of value, if present in water, as indicating recent and objectionable pollution.
>
> "In polluted soils, in crude sewage, in sewage effluents, and in impure waters, I have found streptococci and staphylococci to be present, often in great numbers.
>
> "Although not discarding the class of germs known as staphylococci, I lay less stress upon them for the reason that they comprise hardy germs capable of persisting under conditions the reverse of favourable.
>
> "Streptococci, on the other hand, may, as a class, be thought of as germs especially liable to discouragement by unfavourable physical conditions, and, indeed, as surviving only when the conditions are almost ideally propitious. In the present stage of our knowledge, therefore, the presence of streptococci in a substance, be it soil, or sewage, or water, suggests recent association of certain ingredients of that substance with an animal host. I say this because streptococci are known to inhabit the alimentary tract, and for the reason that the large numbers which I have found, and habitually found, in crude sewage (1,000 or more per cc.) leads me to conclude that the source of these germs is the recent evacuations of animals. I cannot, indeed, persuade myself that multiplication of extruded streptococci is likely to take place in raw sewage to any great extent, if at all; far more likely is it, in my belief, that they rapidly lose their vitality and die. Yet I am not claiming that all streptococci are delicate germs, for my own work is against such a view; nor am I asserting that the absence of streptococci in a water implies "purity or safety." But I contend that, in so far as streptococci, as a class, tend outside the animal body to rapidly lose their vitality and to die; they are micro-organisms to be thought of as of recent animal outcome, and as not unlikely to be, moreover, pathogenic, so that, though their absence in a water may be of little moment, their presence therein is suggestive of recent pollution, and may therefore be of grave importance. In brief, while not considering that the absence of streptococci implies "purity and safety" in a water supply, I am by way of urging somewhat strongly that their presence, at all events in any number, is positive evidence of a sort to go far to justify the bacteriologist in condemning a sample of water as unfit for domestic use."

In describing the *method of procedure* it was pointed out that surface agar cultures (at 37° C.) should be made of the sample of water, and all minute colonies resembling streptococci subcultured in broth; afterwards resorting to further subcultures if a microscopic examination of these broth tubes yielded seemingly positive results. As regards the amount of the sample to be used in

Broth cultures (37° C.).—Diffuse cloudiness.

Litmus-milk cultures (37° C.).—No visible change fourth day. By tenth day the milk has lost some of its purple colour and has a dull, faded look. No clot.

Remarks.—This microbe has been called strepto-staphylococcus. The term is a clumsy one, yet it serves fairly well to signify the morphological position of this micro-organism. The possibility of confusion arising in differential diagnosis of streptococci and staphylococci will not surprise those who are acquainted with the difficulties of investigating micro-organisms of this class.

In view of the fact that this water contained more than eight times as much abuminoid ammonia as would be considered permissible in a drinking water, and is known to be a water subject to pollution of gross and objectionable sort, the question naturally arises—How was it that streptococci were not found to be present in abundance ? Possibly one answer to the question is that the sample was collected before 6 a.m on a Monday morning, *i.e.*, at a time when the canal was free from barge traffic, and the bed of the canal had not been disturbed by the passage of barges for a considerable time. In other words, the contamination may not have been sufficiently *recent* in character to respond unmistakeably to the "streptococcus test."

Experiment II.

A second sample of water was collected from Regent's Canal at Regent's Park.

A.—*Chemical Examination.*

The water was examined for free and albuminoid ammonia. The following results were obtained :—

Free ammonia	0·0296	parts per
Albuminoid ammonia ...	0·08	100,000.

B.—*Bacteriological Examination.*

In searching for streptococci, agar plate cultures were made containing ·1, ·01, ·001, and ·0001 c.c. of the water. These were incubated at 37° C. Ten subcultures in broth were made from minute colonies which developed in one or other of the plates. In eight cases a negative result was recorded as regards streptococci and staphylococci; in the remaining two staphylococci were in each instance found. The following is an account of some of their chief morphological and biological characters :—

Name.—Microbe II.—Staphylococcus.

Source.—0·1 cc. Regent's Canal water, second sample. Agar plate (37° C.).

Morphology.—Stains well by Gram's method. Cocci aggregated together in masses.

Gelatine streak cultures (20° C.).—The colonies were rather large and opaque for a streptococcus, but smaller than is usual with staphylococci. After a few days slow *liquefaction* set in.

Broth cultures (37° C.),—Clear transparent broth, with white viscous growth at the foot of the tube.

Litmus-milk cultures (37° C.).—No visible change in four days.

Remarks.—This microbe was somewhat typical of the kind of staphylococci not uncommonly met with in the examination of polluted waters. They do not, as a rule, possess the luxuriant mode of growth which we are apt to associate with staphylococci (*e.g.*, S. aureus and albus), and tend not unfrequently to imitate the more feeble and delicate streptococci in their biological characters. This circumstance, coupled with the fact that some staphylococci may simulate streptococci morphologically, and *vice versâ*, makes it often difficult, sometimes almost impossible, to assign an organism of this nature to its proper class.

Name.—*Microbe III.*—*Staphylococcus.*

Source.—0·1 cc. Regent's Canal water, second sample. Agar plate (37° C.).

Morphology.—Stains well by Gram's method. Cocci more or less aggregated together to form little clusters or masses.

Gelatine streak cultures (20° C.).—The colonies were small and transparent looking, but after several days *liquefaction* set in, and a faint citron colour was noticeable.

Broth cultures (37° C.).—The broth remained clear and transparent, but at foot of tube and up one side there was a white viscous veil-like growth.

Litmus-milk cultures (37° C.).—No visible change in four days.

Remarks.—This microbe was a liquefying staphylococcus, possibly akin to S. citreus.

This second sample of canal water was collected early on a Tuesday morning. The canal had then been more recently disturbed by barge traffic than in the case of the previous sample. The amount of albuminoid ammonia present in the sample was very similar to the amount found in the first sample, namely, about eight times as much as would pass muster in the case of a potable water. No streptococci could, however, be found in 0·1 c.c. of the water.

With regard to streptococci, it must be remembered that in the case of Sample II., as of Sample I., notwithstanding the large amount of organic pollution, there was no direct evidence that recent contamination with animal organic matter had taken place at or near the spot where the samples were collected, although the presumption to this effect was somewhat greater in the case of Sample II.

EXPERIMENT III.

A sample of water was collected from the Brent River, about 100 yards below where the effluent from the Hendon Sewage Works enters the river. The sample was collected during heavy rains, and contained much mud and suspended matters.

A.—*Chemical Examination.*

The sample was examined for free and albuminoid ammonia, and yielded the following results:—

Free ammonia	2·5	parts per 100,000.
Albuminoid ammonia ...	0·36	

B.—*Bacteriological Examination.*

Agar plate cultures were made containing respectively 0·01, 0·001, and 0·0001 c.c. of the water. These were incubated at

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37° C. Six colonies from one or other plate were subcultured in broth. In three cases no growth occurred, in one a growth but not of a streptococcus, and in the remaining two streptococci, as under:—

Name.—Microbe IV.—Streptococcus.

Source.—·0001 cc. Brent River water. Agar plate (37° C.).

*Morphology.**—Stains well by Gram's method. Cocci united together to form short chains. Occasionally a longer chain observed. In some preparations the chains of cocci showed a tendency to run together to form little masses. Involution forms occur even in young cultures.

Surface plate cultures (under a low power of the microscope):—

(a) *Gelatine* (20° C.)—Minute, transparent, somewhat irregularly-shaped colonies, showing faint wavy granulation. No loops visible at the periphery of the colonies. No liquefaction.

(b) *Agar* (37° C.).—Small transparent colonies, nearly circular in shape and showing distinct wavy granulation, but no loops at the periphery.

Gelatine streak cultures (20° C.).—The colonies are very small and transparent looking. No liquefaction occurs.

Broth cultures (37° C.).†—Abundant diffuse cloudiness; at the foot of the tube there is a white growth which, on gently shaking the tube, floats throughout the medium in streamer fashion.

Litmus-milk cultures (37° C.).—No visible change in 24 hours; later, slight acidity. No clot (ninth day).

Remarks.—This streptococcus was isolated from so minute a quantity as ·0001 c.c. of the water. It was intended to inoculate mice with this streptococcus, but a culture in broth made not long after the original isolation of the microbe gave a very feeble growth, showing that the streptococcus had already lost much of its vitality. A similar remark applies to Microbes VII. and VIII.

Name.—Microbe V.—Streptococcus.

Source.—·001 cc., Brent River water. Agar plate (37° C.).

Morphology.‡—Stains well by Gram's method. Cocci in short chains; occasionally a chain of medium length may be seen. The chains show some tendency to run together to form masses. Involution forms extremely well marked, even in young cultures.

Surface plate cultures (under a low power of the microscope):—

(a.) *Gelatine* (20° C.).—The appearances are very similar to those noted under Microbe IV., but the colonies are, if anything, even smaller, more transparent looking, and less granular in character. No liquefaction.

(b.) *Agar* (37° C.).—Resembles Microbe IV. somewhat closely, but the colonies appear to be even more minute; they are also less granular and more transparent looking.

Gelatine streak cultures (20° C.).—Very similar to Microbe IV., but the colonies are extremely minute. No liquefaction.

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* Figure 13, Plate XXXV, is a microscopic preparation (stained by Gram's method) from a young agar culture. It shows the occasional long chains and the most common very short chains, also involution forms.

† Figure 5 (left tube), Plate XXXIII, shows very well the appearance produced in broth culture. This "diffuse cloudiness appearance" is commonly produced in broth cultures by the "short-chain" varieties of streptococci.

‡ Figure 14, Plate XXXV, is a microscopic preparation (stained by Gram's method) from a young agar culture. Note the involution forms showing as spindle-shaped and oval elements.

Broth cultures (37° C.).*—Abundant diffuse cloudiness; at the foot of the tube a white viscous deposit collects.

Litmus-milk cultures (37° C.).—No visible change even after nine days.

Remarks.—This streptococcus, which bore many points of resemblance to Microbe IV., was isolated from ·001 cc. of the water. One cc. of a broth culture (48 hours at 37° C.) was inoculated subcutaneously in a mouse. The animal, however, remained apparently unaffected.

In this instance the water of a stream, extensively and recently contaminated by sewage effluent, was found to contain streptococci in as small amounts as ·001 and ·0001 cc.

EXPERIMENT IV.

A sample of water was collected from a polluted tidal river (N—— River) below and at some little distance from the points of entrance of the main sources of contamination. This river is contaminated with sewage which is discharged into it at a number of different points without preliminary treatment of any kind, and in a more or less solid condition. Although the amount of sewage is large, the dilution is very great, and it has been stated by competent authorities that the river water is well aërated.

A.—*Chemical Examination.*

The water was examined for free and albuminoid ammonia and oxygen absorbed from permanganate. The results were as follows:—

Free ammonia	0·0272	parts per 100,000.
Albuminoid ammonia ...	0·024	
Oxygen absorbed from permanganate (4 hours) ...	0·106	

B.—*Bacteriological Examination.*

Although this report is chiefly concerned with an account of the presence or absence of streptococci in the various samples of water, it may not be amiss to give the following notes on other bacterial tests.

The water was found to contain 39,200, 11, and 1,600 bacteria, spores of aerobic bacteria, and B. coli (or closely allied forms) respectively per cc. 1 cc. (but not ·1 cc.) of the water produced "gas" in gelatine shake cultures in 24 hours at 20° C. There were no thermophilic bacteria (*i.e.*, bacteria surviving a temperature of 68° C.) present in 1 cc. The spores of B. enteritidis sporogenes were present in 10 cc., but not in 1 cc. of the water.

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* Figure 5 (right tube), Plate XXXIII., shows the "diffuse cloudiness appearance," produced by the growth of this microbe in broth culture. The "short-chain" varieties of streptococci usually produce a more or less uniform turbidity in broth culture.

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In searching for streptococci the river water was diluted with measured quantities of sterile distilled water, and agar cultures made. The results obtained were as follows:—

Name.—Microbe VI.—Streptococcus.

Source.—·01 cc. of river water (N—— River, Experiment IV.). Agar plate (37° C.).

Morphology.—Stains well by Gram's method. Extremely long chains of cocci. Resembles S. Longus.

Broth cultures (37° C.).—The broth remained absolutely transparent. At the foot of the tube there is a white cloudy, cumulus-like growth.

Remarks.—This streptococcus appeared to be identical with Microbes VII. and VIII., about to be described.

Name.—Microbe VII.—Streptococcus.

Source.—·01 cc. of river water (N—— River, Experiment IV.).—Agar plate (37° C.).

*Morphology.**—Stains well by Gram's method. Immensely long chains of cocci.

Plate cultures (under a low power of the microscope):—

(a.) *Gelatine* (20° C.).—Small transparent colonies, which may be seen to be composed of an entanglement of loops, apparently without beginning or end. No liquefaction.

(b.) *Agar* (37° C.).—Minute transparent colonies of irregular shape. Made up of a loose entanglement of loops, which seem to be without beginning or end. The loops of streptococci are clearly visible, not only at the periphery, but throughout the whole colony.

Gelatine streak cultures (20° C.).—Small transparent colonies of somewhat irregular shape. No liquefaction.

Broth cultures (37° C.).—Absolutely transparent broth, with, at foot of the tube, a white fleecy, cumulus-like growth.

Litmus-milk cultures (37° C.).—No visible change in 24 hours; later acidity. No clot sixth day, but distinct acidity.

Remarks.—This streptococcus seemed to be identical with Microbes VI. and VIII.

Name.—Microbe VIII.—Streptococcus.

Source.—·01 cc. of river water (N—— River, Experiment IV.). Agar plate (37° C.).

Morphology†.—Stains well by Gram's method. Extremely long chains of cocci.

Plate cultures (Gelatine at 20° C., and agar at 37° C.). *Gelatine streak cultures* (20° C.). *Broth cultures* (37° C.).‡ *Litmus-milk cultures* (37° C.).	The growth in these media was similar in every respect to the growth of Microbe VII.

Gelatine at 37° C. §—A white granular deposit collects at the foot of the tube, and throughout the medium white specks of granular appearance are scattered.

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* Figure 15, Plate XXXV., is a microscopic preparation (stained by Gram's method) made from a broth culture (24 hours at 37° C.). x1000. Note the extremely long chains of cocci.

† Figure 16, Plate XXXVI., is a microscopic preparation (stained by Gram's method) made from a broth culture (24 hours at 37° C.). x1,000.

‡ Figure 17 (right tube), Plate XXXVI., shows very well the appearances produced in broth cultures by the growth of this streptococcus. Note the transparency of the medium and the white cloudy mass at the foot of the tube.

§ Fig. 17 (middle tube), Plate XXXVI.

Remarks.—This streptococcus appeared to be identical with Microbes VI. and VII. They were all isolated from a single sample containing ·01 cc. of the river water.

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Name.—Microbe IX.—Staphylococcus.

Source.—·01 cc. of river water (N—— River, Experiment IV.). Agar plate (37° C.).

Morphology.—Stains well by Gram's method. Cocci chiefly in masses (staphylococcus formation), although here and there in the preparations short chains could be seen.

Plate cultures (under a low power of the microscope) :—

(a) *Gelatine* (20° C.).—The colonies are circular, granular looking, with *clean* edge. But although small, they seemed too opaque for a streptococcus.

(b) *Agar* (37° C.).—Here the colonies are more transparent. They are small, granular looking, and circular, with *clean* edge.

Gelatine streak cultures (20° C.).—The colonies remained small, and were for the most part separate. But they were opaque rather than transparent in character, and after some days, liquefaction set in.

Broth cultures (37° C.).—Diffuse, but not very abundant cloudiness.

Litmus-milk cultures (37° C.).—No visible change in 48 hours; by eighth day slight acidity, but no clot.

Remarks.—This microbe was classed as a staphylococcus.

Name.—Microbe X.—Bacillus simulating a streptococcus.

Source.—·01 cc. river water (N—— River, Experiment IV.). Agar plate (37° C.).

Morphology.—Stains well by Gram's method. Fairly long chains made up of bacillary forms and often some cocci. The bacillary elements are usually swollen and irregular in shape.

Plate cultures (under a low power of the microscope) :—

(a) *Gelatine* (20° C.).—The colonies were large and opaque, and not streptococcus-like in character.

(b) *Agar* (37° C.).—Most of the colonies were large and opaque, but some were small, of transparent appearance, and showing wavy granulation and a "frayed" edge..

Gelatine streak cultures (20° C.).—The growth tends to be confluent, and the separate colonies large and opaque.

Broth cultures (37° C.).—Diffuse, but not very abundant cloudiness.

Litmus-milk cultures (37° C.).—No visible change eighth day.

Remarks.—This microbe was finally classed as a bacillus, simulating, however, to some extent a streptococcus.

Observations on results obtained in Experiment IV.—It is to be noted that we are here dealing with a sample taken from a river which, notwithstanding its large volume, must needs anywhere in the neighbourhood of the point of collection have been recently, and perhaps grossly, polluted with matters of animal outcome. The chemical results indicate that as regards albuminoid ammonia the water contained less than three times the amount which would ordinarily pass muster in a potable water, and as regards oxygen absorbed from permanganate the water even might have been classed as of "medium organic purity." Ordinarily employed bacterial tests indicated pollution with

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organic matter of animal outcome in a much more unmistakeable way. The samples contained the spores of B. enteritidis sporogenes in 10 cc., produced gas in a gelatine shake culture containing 1 cc. of the water in 24 hours, and yielded over 39,000 microbes per cc., of which more than 1,500 were B. coli (or closely allied forms).

The result to the streptococcus test appears equally definite, and, if positive results to this test be admitted as evidence of animal pollution, the delicacy of the test is noteworthy. In the case of this river water $\frac{1}{100}$ cc. sufficed to show the presence of streptococci.

EXPERIMENT V.

A sample of Thames water was collected at Blackfriars, at low tide, and on the south side of the river.

A.—*Chemical Examination.*

The water was examined for free and albuminoid ammonia with the following results :—

Free ammonia	0·128	parts per 100,000.
Albuminoid ammonia ...	0·1008	

B.—*Bacteriological Examination.*

The Thames water was diluted with definite quantities of sterile water and a series of agar plate cultures made. These were incubated at 37° C., and the minute colonies sub-cultured in broth. In a number of cases the examination of the broth tubes yielded negative results, but in two of the cultures a positive result was obtained, as under :—

Name.—*Microbe XI.*—*Streptococcus.*

Source.—·001 cc. Thames water. Agar plate (37° C.).

*Morphology.**—Stains well by Gram's method. A streptococcus forming short chains.

Plate cultures (under a low power of the microscope) :—

(a) *Gelatine* (20° C.).—Grew very slowly, and apparently with great difficulty. By fourth day a few minute circular transparent faintly-granular colonies, with *clean* edge. No liquefaction.

(b) *Agar* (37° C.).—Minute circular faintly-granular and transparent colonies, with *clean* edge.

Gelatine streak cultures (20° C.).—The growth is very slow. At first sight it looks like a continuous thin film, but on closer examination the growth is seen to be composed of numberless separate minute and transparent-looking colonies. No liquefaction.

Broth cultures (37° C.).†—Abundant diffuse cloudiness.

Litmus-milk cultures (37° C.).—No visible change, unless a trace of acidity.

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* Figure 18, Plate XXXVI.

† Figure 17 (left tube), Plate XXXVI. Note the appearance as of diffuse cloudiness. The "short-chain" varieties of streptococci are apt to produce this appearance in broth culture, just as the "long-chain" forms tend to leave the broth clear, with a woolly growth at the foot of the tube.

Remarks.—This microbe was unquestionably a streptococcus. Its biological characters were somewhat typical of the manner of growth of the "short-chain" varieties of streptococci. These microbes commonly produce uniform turbidity in broth culture, and the colonies in gelatine and agar tend to be very minute, circular, transparent, only faintly granular, and the edges *clean* and unbroken in outline. Two mice were inoculated subcutaneously, each with 1 cc. of a broth culture (48 hours at 37° C.). One died on the fourth day, but the other remained apparently unaffected.

Name.—Microbe XII.—Streptococcus.

Source.—·001 cc. Thames water. Agar plate (37° C.).

Morphology.[*]—Stains well by Gram's method. A streptococcus forming short chains. The chains, however, are longer than in the case of Microbe XI.

Plate cultures (under a low power of the microscope):—

(a) *Gelatine* (20° C.).—Grew very slowly, and apparently with great difficulty. By the fourth day a few minute colonies resembling very closely those of Microbe XI. No liquefaction.

(b) *Agar* (37° C.).—The growth was nearly identical in character with the growth of Microbe XI.

Gelatine streak cultures (20° C.).—Resembles the growth of Microbe XI. No liquefaction.

Broth cultures (37° C.).
Litmus-milk cultures (37° C.). } Not to be distinguished from Microbe XI.

Remarks.—This streptococcus was evidently a close ally of Microbe XI., but the chains of cocci were longer. Two mice were inoculated subcutaneously, each with 1 cc. of a broth culture (48 hours at 37° C.). One died on the fourth day and the other on the seventh day, but cultures from the spleen yielded negative results as regards the presence of streptococci.

In this instance the contrast between chemical tests and the streptococcus test is well brought out. The chemical results do indeed indicate unmistakeably that organic matter of *some kind* is present in undesirable proportions. The streptococcus test here appears to indicate, with greater delicacy than the chemical tests, the presence of the particular kind of organic matter which it is most necessary to detect in water, namely, that of apparently recent animal origin.

EXPERIMENT VI.

A sample of water was collected from the same source (N—— River) as Experiment IV, but at a point where the pollution was even more gross in amount and more recent in character.

A.—*Chemical Examination.*

The water was examined for free and albuminoid ammonia and oxygen absorbed from permanganate. The results were as follows:—

Free ammonia	0·1596	parts per 100,000.
Albuminoid ammonia	0·07	
Oxygen absorbed from permanganate (4 hours)	0·3758	

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[*] Figure 19, Plate XXXVII.

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B.—*Bacteriological Examination.*

The water was found to contain per cc. a total of 1,240,000 bacteria, 9 spores of aerobic bacteria, and 20,000 B. coli (or closely allied forms) respectively per cc. 0·1 cc. of the water produced "gas" in gelatine shake cultures in 24 hours at 20° C. There were no thermophilic bacteria (68° C.) present in 1 cc. The spores of B. enteritidis sporogenes were present in $\frac{1}{100}$ but not in $\frac{1}{1000}$ cc. of the sample.

In searching for streptococci, the water was diluted with measured amounts of sterile water and a series of agar cultures (at 37° C.) made. The results obtained were as follows :—

Name.—Microbe XIII.—A bacillus simulating on preliminary observation a streptococcus.

Source.—·0001 cc. river water (N—— River, Experiment VI.). Agar plate (37° C.).

Morphology.—Stains well by Gram's method. Appeared to be a bacillus simulating a streptococcus. The individual elements were markedly irregular in shape and size.

Broth cultures (37° C.).—The broth remained clear and transparent, but with granular white little masses scattered throughout the liquid and lying at the foot of the tube.

Gelatine streak cultures (20° C.).—The colonies were large and opaque, and quite unlike the growth of a streptococcus.

Remarks.—The study of this microbe was early abandoned as it was evidently not a streptococcus.

Name.—Microbe XIV.—Streptococcus.

Source.—·001 cc. river water (N—— River, Experiment VI.). Agar plate (37° cc.).

*Morphology.**—Stains well by Gram's method. A streptococcus forming short chains, but also showing some tendency towards mass formation.

Plate cultures (under a low power of the microscope) :—

(a) *Gelatine* (20° C.).—The colonies are minute, transparent, of circular shape, with clean edge, and show only very faint granulation. No liquefaction.

(b) Agar (37° C.).—Minute nearly circular colonies of transparent appearance. Wavy granulation is well marked. Some of the colonies show a slightly "frayed" edge and others a suspicion of loops of cocci at the periphery.

Gelatine streak cultures (20° C.).—The colonies are separate from each other and are minute and transparent in appearance. No liquefaction.

Broth cultures (37° C.).—The broth remains nearly transparent. On the sides of the tube there is a white tendril-like growth. On gently shaking the tube the growth is detached and floats throughout the medium in streamer-fashion.

Litmus-milk cultures (37° C.).—Acidity, but no clot.

Remarks.—1 cc. of a broth culture (48 hours at 37° C.) was inoculated subcutaneously into a mouse, but the animal remained apparently unaffected.

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* Figure 20, Plate XXXVII.

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By way of illustration of the use of the streptococcus test, it will not be out of place to note the successive inferences which may, it seems to me, be legitimately drawn from the qualitative bacteriological examination in this case. They are, firstly, that the water at one time or another had been grossly polluted with excremental matters (100 spores of B. enteritidis sporogenes per cc.).

Secondly, that the contamination could not conceivably be regarded as remote (much less unobjectionable) in character (20,000 B. coli per cc.); and

Lastly, that the presumptive evidence was very strong that the pollution was of *quite recent* (and therefore of especially dangerous) kind (streptococci in $\frac{1}{1000}$ cc.).

EXPERIMENTS VII. to X.

Experiments VII., VIII., IX., X. are grouped together because although they were all collected at points on the N-—— River, they nevertheless bore a less close relation to pollution with excremental matters of recent animal outcome than experiments IV. and VI. Thus the sample in Experiment X. was collected about seven miles below the chief sources of pollution; in Experiment VII., at full tide and during a slight flood; and in Experiment VIII. during a high flood. Experiment IX., although collected from a polluted area, bore a much less close relation to recent contamination than Experiments IV. and VI.

Each of these four experiments yielded negative results as regards the presence of streptococci[*] (that is in $\frac{1}{10}$ cc.) although showing abundant evidence of *past* pollution by other methods.

A.—*Chemical Examination.*

The results of the chemical examination of these waters are given below:—

PARTS PER 100,000.

Experiment.	Free Ammonia.	Albuminoid Ammonia.	Oxygen absorbed from Permanganate (4 hours).
Experiment VII.... ...	0·032	0·04	0·486
" VIII.... ...	0·0048	0·032	0·48
" IX.... ...	0·004	0·02	0·312
" X.... ...	0·012	0·024	0·1474

[*] A staphylococcus was isolated from ·1 cc. of sample IX.

B.—*Bacteriological Examination.*

The bacteriological results were as under :—

Experiment.	Total number of bacteria in 1 cc. (gelatine at 20° C.).	Number of spores of aërobic bacteria in 1 cc.	"Gas" in gelatine "shake" cultures in 24 hours at 20° C.			Streptococci (agar at 37° C.) in ·1 cc.	Thermophilic bacteria 1 cc. of water in broth at 68° C.	Number of B. coli (or closely allied forms) in 1 cc.	Detection of spores of B. enteritidis sporogenes (Klein).				
			1 cc.	·1 cc.	·01 cc.				10 cc.	1 cc.	·1 cc.	·01 cc.	·001 cc.
Experiment VII. ...	80,000	57	+	+	—	—	—	1,000	...	...	+	—	...
" VIII. ...	34,600	100†	+	—	...	—	+	10	+	—	...	...	...
" IX. ...	10,400	40	—*	...	...	—	—	100	+	—	...	...	...
" X. ...	8,000	16	+	—	...	—	—	10	+	—	...	...	...

* + in 36 hours.

† This sample, as already stated, was collected in time of flood.

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The following is a brief account of some of the morphological and biological characters of the staphylococcus isolated from Experiment IX.:—

Name.—*Microbe XV.*—*Staphylococcus.*

Source.—0·1 cc. river water (N—— River, Experiment IX.). Agar plate, 37° C.

Morphology.—Stains well by Gram's method. Cocci usually gathered together in little clusters.

Gelatine streak cultures (20° C.).—The growth was white, opaque, and confluent in character. In two days *liquefaction* set in.

Broth cultures (37° C.).—The broth remained absolutely transparent. The growth at the foot and side of the tube was white and veil-like in character, and looked almost as if it had been combed.

Litmus milk cultures (37° C.).—In two days distinct alkali production.

Remarks.—Microbe XV. was unquestionably a staphylococcus.

In summary of the results of Experiments VII.–X. it is to be noted that the samples of water contained from twice to four times as much albuminoid ammonia as would be considered permissible in a drinking water. Bacteriologically considered, with reference to tests for B. coli and B. enteritidis sporogenes, they were from at least ten to one hundred times more impure than potable water to which bacterially no exception need be taken. Streptococci, however, were in each instance absent when sought for in $\frac{1}{10}$ cc. of the samples. In Experiments VIII. and X. it is manifest that there was small hope of isolating streptococci in $\frac{1}{10}$ cc., since these samples contained no more than 10 B. coli per cc. In Experiments IX. and VII. the case was somewhat different, since B. coli was present in far greater proportion, namely, 100 and 1,000 respectively per cc. Possibly streptococci might have been found if the water had been filtered through a Pasteur filter and the "filter brushings" submitted to examination. I am, however, of opinion that the failure to find them in these experiments was largely, if not entirely, due to the streptococci having lost their vitality during the considerable interval which elapsed between their having been discharged into the river and their collection.

Lest it should be asked: Of what value is this test if it fails in the presence of pollution of sufficiently gross character to be demonstrated both by chemical means and by ordinary bacterial tests? let it be remembered that no claim has been made that the *absence* of streptococci necessarily implies "purity or safety," but only that their *presence* is significant of animal pollution of recent sort. No conclusion whatever can be safely drawn from the absence of streptococci, although it may perhaps hereafter be established that the absence of streptococci from a *considerable bulk of water* ("filter-brushing method") is negative evidence of a sort which may go far to justify the bacteriologist in assuming the absence of *very recent*, and therefore presumably *specially dangerous*, animal pollution.

EXPERIMENT XI.

The sample of water (N—— River) was collected 25 yards below the entrance into the river of a main sewer.

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A.—*Chemical Examination.*

The results were as follows :—

Free ammonia	0·22	parts per 100,000.
Albuminoid ammonia ...	0·152	
Oxygen absorbed from permanganate (4 hours) ...	0·54	

B.—*Bacteriological Examination.*

The water was found to contain, respectively, per cc., 1,168,000 bacteria; 261 spores of aerobic bacteria; and 60,000 B. coli (or closely allied forms). 0·01 cc. of the water produced "gas" in gelatine "shake" cultures in 24 hours at 20° C. There were no "thermophilic" bacteria (68° C.) present in 1 cc. The spores of B. enteritidis sporogenes were present in $\frac{1}{100}$ but not in $\frac{1}{1000}$ cc. of the sample.

In searching for streptococci the water was diluted with measured amounts of sterile water, and a series of agar cultures (at 3 ° C.) made. It will be seen from the following results that streptococci were isolated from so minute a quantity of the water as $\frac{1}{10000}$ cc.:—

Name.—Microbe XVI. Streptococcus.

Source.—$\frac{1}{10000}$ cc. of river water (N—— River, Experiment XI.). Agar plate (37° C.).

*Morphology.**—Stains well by Gram's method. Cocci in chains of medium length.

Plate cultures (under a low power of the microscope) :—

(a) *Gelatine* (20° C.).—Minute, transparent, nearly circular colonies with *clean* edge. The colonies are faintly granular and many of them have a nucleated appearance. No liquefaction.

(b) *Agar* (37° C.).—Minute, transparent, nearly circular colonies with slightly frayed edge, but not showing definite loops at the periphery. The colonies are more granular looking than those in gelatine culture.

Gelatine "streak" cultures (20° C.).—Minute, transparent, circular colonies. No liquefaction.

Broth cultures (37° C.).—Diffuse cloudiness, but also granular and flocculent cloudiness as well.

Litmus milk cultures (37° C.).—No visible change in forty-eight hours. By third day slight acidity. By seventh day strong acidity but no clot.

Remarks.—Microbe XVI. was unquestionably a streptococcus. 1 cc. of a twenty-four hours' broth culture (37° C.) was inoculated subcutaneously into each of two mice: the result was negative. Here and in all other experiments the mice were not kept under observation beyond ten days to a fortnight, the reason being that my endeavour was not to see whether the microbes were feebly pathogenic but whether they were or were not distinctly virulent.

Name.—Microbe XVII. Streptococcus.

Source.—$\frac{1}{10000}$ cc. of river water (N—— River, Experiment XI.). Agar plate (37° C.).

Morphology.†—Stains well by Gram's method. Cocci in chains of short to medium length.

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* Figures 21 and 22, Plate XXXVII. † Figure 23, Plate XXXVIII.

Plate cultures (under a low power of the microscope) :—

(a) *Gelatine* (20° C.).
(b) *Agar* (37° C.).
} The colonies were very similar in appearance to Streptococcus XVI.

Gelatine "streak" cultures (20° C.).—The growth appeared to be identical with Streptococcus XVI.

Broth cultures (37° C.).—Some diffuse cloudiness, but cloudiness also granular in character. The deposit at the foot of the tube was granular and flocculent in appearance.

Litmus-milk cultures (37° C.).—No visible change in 48 hours. By third day strong acidity, fifth day "weak" clot, seventh day strong acidity and "weak" clot.

Remarks.—This streptococcus resembled very closely Streptococcus XVI. Two mice inoculated each with 1 cc. of a 24 hours' broth culture (37° C.) remained apparently unaffected.

Name.—Microbe XVIII. Streptococcus.

Source.—$\frac{1}{10000}$ cc. of river water (N—— River, Experiment XI.). Agar plate (37° C.).

Morphology.[*]—Stains well by Gram's method. Cocci in chains of medium length. Involution forms well marked.

Plate cultures (under a low power of the microscope) :—

(a) *Gelatine* (20° C.).—Minute, transparent, usually circular colonies with *clean* edge, and showing only very faint granulation. No liquefaction.

(b) *Agar* (37° C.).—The colonies resemble those in gelatine cultures except that granulation is more distinct.

Gelatine "streak" cultures (20° C.).—The colonies are minute, more or less circular in shape, and transparent looking. No liquefaction.

Broth cultures (37° C.).—The broth remains nearly transparent, with cirrhus-like growths floating throughout the liquid. At the foot of the tube is a white viscous growth which on gently shaking the tube rises and spreads itself in streamer-like fashion.

Litmus-milk cultures (37° C.).—No visible change, even after five days.

Remarks.—Microbe XVIII. was unquestionably a streptococcus. Two mice were inoculated subcutaneously, each with 1 cc. of a three days' broth culture (37° C.). One died on the seventh day, but the other remained apparently unaffected.

In the case of this Sample XI., pollution of gross amount with organic matter, recent or remote in origin, was plainly shown by chemical analysis. That this pollution was probably comparatively recent was further indicated by the bacterial tests which are ordinarily employed. The sample of water contained no fewer than 4,168,000 bacteria, 60,000 B. coli (or closely allied forms), and 100 spores of B. enteritidis sporogenes, respectively, per cc. Now, as regards the streptococcus test in this case, where as a matter of fact the pollution was so recent that the water might be regarded as highly diluted fresh sewage, the indications were quite unmistakeable and tend to confirm the view that affirmative response to this test is a valuable index of quite recent, and, if drinking water had been in question particularly dangerous, pollution with animal organic matter. For *streptococci were present in so minute a quantity* as $\frac{1}{10000}$ cc.

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[*] Fig. 24, Plate XXXVIII. Note the well-marked oval and spindle-shaped involution forms.

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On the Value of Examination of Water for Streptococci and Staphylococci with a view to detection of its Recent Contamination with Animal Organic Matter; by Dr. Houston.

EXPERIMENT XII.

The sample of water (N—— River) was collected above the sewer outfalls. The river, however, was in high flood, and so might have obtained some recent contamination by way of "soil washings." Although yielding negative results as regards the presence of streptococci, the records are of some interest.

A.—*Chemical Examination.*

The results were as follows:—

Free ammonia	0·0064	parts per 100,000.
Albuminoid ammonia	0·052	
Oxygen absorbed from permanagate (4 hours)	0·56	

B.—*Bacteriological Examination.*

The results were as follows, respectively, per cc. of the sample:—18,300 bacteria and 117 spores of aerobic bacteria were present. 1 cc. of the water produced "gas" in gelatine "shake" culture in 24 hours. There were no "thermophilic" bacteria (68° C.) present in 1 cc. The number of spores of B. enteritidis sporogenes was at least 1, but less than 10 per cc. No B. coli and no streptococci could be found in 0·1 cc. of the sample.

No microbes bearing any resemblance to streptococci or staphylococci were detected.

As regards the chemical results, it is noteworthy that the amount of oxygen absorbed from permanganate was actually greater in this sample than in the previous one, and the albuminoid ammonia was only about one-third less.

The bacteriological results showed that the water contained an excessive number of bacteria, but it is of interest to note that the number of spores of aerobic bacteria was large (both actually and relatively to the total bacterial flora), pointing to the presence of "flood" water in the sample. The presence of "flood" water would certainly cause a great increase in the number of microbes. Whether such an increase ought to be regarded with suspicion or not would greatly depend on the species of bacteria. Compare the ratios of spores to bacteria in this sample (1 : 156) with the previous one (1 : 44,923). Further, no B. coli and no streptococci were found in $\frac{1}{10}$ cc., whereas in the previous sample the number of B. coli was 60,000 per cc., and streptococci were present in $\frac{1}{10000}$ cc. It is true that B. enteritidis sporogenes was present in 1 cc. (in the previous experiment it was present in ·01 cc.), but the spores of this microbe are always present in abundance in cultivated soils, and in the "washings" (*e.g.*, "flood water") from such soils, and its presence does not necessarily imply recent pollution. It is not contended that "flood water" is not objectionable, far from it, but only that a proper appreciation of the kinds of bacteria to be associated with recent pollution, in contrast to those to be thought of as less closely related to the evacuations of animals, enables one to say, with some measure of confidence, whether the danger is likely to be actual or potential in character.

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EXPERIMENT XIII.

The sample of water (N—— River) was collected about 25 yards below the point of entrance into the river of a large sewer.

A.—*Chemical Examination.*

The results were as follows :—

Free ammonia	0·096	parts per 100,000.
Albuminoid ammonia ...	0·055	
Oxygen absorbed from permanganate (four hours) ...	0·206	

B.—*Bacteriological Examination.*

The results were as follows, per cc. of sample examined :—74,000 bacteria; 9 spores* of aerobic bacteria; 10,000 B. coli (or closely allied forms); and 10 spores of B. enteritidis sporogenes. $\frac{1}{10}$ cc. of the sample produced "gas" in gelatine "shake" culture in 24 hours at 20° C. "Thermophilic" bacteria (68° C.) were present in 1 cc. of the water.

In searching for streptococci the water was diluted with measured volumes of sterile water and a series of agar cultures (at 37° C.) made. A streptococcus was isolated from $\frac{1}{10}$ cc. of the sample of water.

Name.—*Microbe XIX. Streptococcus.*

Source.—0·1 cc. river water (N—— River, Experiment XIII.). Agar plate (37° C.).

Morphology.—Stains well by Gram's method. Cocci occurring in short to medium chains.

Remarks.—Unfortunately, circumstances arose which entirely prevented me from studying this microbe more fully. That it was a streptococcus need not be doubted.

EXPERIMENT XIV.

The sample of water (N—— River) was collected above all sources of pollution, and higher up the river than in Experiment XII., and not during a "flood." From the negative point of view the results are not devoid of interest.

[In recapitulation of what has been already stated :—Samples IV., VI., XI., and XIII. all bore a close relation to pollution with excremental matters of recent animal outcome. Samples VII., VIII., IX., and X., although also obviously polluted, were less closely related than the above samples to animal matters recently extruded. Samples XII., and XIV. (particularly the latter) were collected above the main sources of pollution which rendered the foregoing samples so objectionable in character. All these samples (IV., VI.—XIV.) were collected from the same river (N—— River), at different points along its course.]

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* The results in this as well as in the previous experiments afford confirmation of the contentions made in previous reports, namely, that the number of spores (both actually and relatively to the total bacterial flora) of aerobic bacteria is small in waters. In surface soils and the "washings" therefrom the number is very great (actually and relatively), as has been shown conclusively in three successive reports.

A.—*Chemical Examination.*

The results were as follows:—

Free ammonia	0·004	parts per 100,000.
Albuminoid ammonia ...	0·0112	
Oxygen absorbed from permanganate (four hours) ...	0·0774	

B.—*Bacteriological Examination.*

The following results were obtained per cc. of the sample:—430 bacteria; 18 spores of aerobic bacteria. No "gas" in gelatine "shake" cultures containing 1 cc. of the water in 24 hours. No spores of B. enteritidis sporogenes in 10 cc.; no B. coli in 0·1 cc.; no streptococci in 0·1 cc.

Chemically considered this water would probably be classed as of "medium organic purity." The bacteriological results gave no evidence of objectionable pollution. It is of interest to place the chemical and bacteriological results obtained in Experiments XI. and XIV. side by side for comparison.

—	Free Ammonia.	Albuminoid Ammonia.	Oxygen absorbed from Permanganate (four hours).
Experiment XI.	0·22	0·152	0·54
" XIV.... ...	0·004	0·0112	0·0774
Ratios	(55 : 1)	(13 : 1)	(7 : 1)

—	Total number of bacteria.	"Gas" in gelatine "shake" cultures.	Streptococci.	B. coli (or closely allied forms).	Spores of B. enteritidis sporogenes.
Experiment XI. ...	1,168,000 in 1 cc.	+ in $\frac{1}{100}$ cc.	+ in $\frac{1}{10000}$ cc.	60,000 in 1 cc.	100 in 1 cc.
Experiment XIV. ...	430 in 1 cc.	— in 1 cc.	— in $\frac{1}{10}$ cc.	— in $\frac{1}{10}$ cc.	— in 10 cc,
Ratios	(2,716 : 1)	(100 : 0)	(1,000 : 0)	(6,000 : 0)	(1,000 : 0)

In the next section, three further experiments may be given. They deal with the chemical and bacteriological examination of the mud of the bed of N—— River. In each instance the samples were collected from portions of the river subject to gross fouling with excremental matters.

SECTION II.

On the Value of Examination of Water for Streptococci and Staphylococci with a view to detection of its Recent Contamination with Animal Organic Matter; by Dr. Houston.

CHEMICAL AND BACTERIOLOGICAL EXAMINATION OF THREE SAMPLES OF POLLUTED MUD, WITH PARTICULAR REFERENCE TO THE PRESENCE OR ABSENCE OF STREPTOCOCCI. EXPERIMENTS A, B, C.

These 3 samples were as follows:—

A, B, and C.—From the bed of N—— River. Collected at different points, but in each instance from portions of the river subject to gross contamination with "untreated" sewage.

EXPERIMENT A.

300 grammes of the mud from the bed of N—— River were thoroughly mixed with 300 cc. of sterile water. The mixture of mud and water was allowed to settle for ¼ hour. A portion of the comparatively clear liquid from near the surface was siphoned off, and this was used for the chemical and bacteriological examination.

A.—*Chemical Examination.*

Free ammonia	0·56	Parts per 100,000.
Albuminoid ammonia	1·6	
Oxygen absorbed from permanganate (four hours)	14·4	

B.—*Bacteriological Examination.*

1,660,000 bacteria; at least 1,000 B. coli (or closely allied forms) and at least 100 spores of B. enteritidis sporogenes in 1 cc. ·01 cc. produced "gas" in a gelatine "shake" culture in 24 hours.

A streptococcus was isolated from an agar plate culture (37° C.) containing $\frac{1}{1000}$ cc.

EXPERIMENT B.

400 grammes of the mud from the bed of N—— River were thoroughly mixed with 400 cc. of sterile water. The mixture of mud and water was allowed to settle for ¼ hour. A portion of the comparatively clear liquid from near the surface was siphoned off and this was used for the chemical and bacteriological examination.

A.—*Chemical Examination.*

Free ammonia	0·4	Parts per 100,000.
Albuminoid ammonia	0·7	
Oxygen absorbed from permanganate (four hours)	3·51	

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B.—*Bacteriological Examination*

The following results were obtained per cc. of liquid examined:—11.800,000 bacteria; 10,000 B. coli (or closely allied forms); at least 1,000 spores of B. enteritidis sporogenes. ·01 cc. produced "gas" in a gelatine "shake" culture in 24 hours.

The following is a description of a streptococcus isolated from $\frac{1}{1000}$ cc.

Name.—Microbe XX. Streptococcus.

Source.—$\frac{1}{1000}$ cc. "washings" of 400 grammes mud (Experiment B) of N—— River, agar plate culture (37° C.).

*Morphology.**—Stains well by Gram's method. An undoubted streptococcus forming extremely long chains.

Gelatine "streak" cultures (20° C.).—Minute, separate and very transparent looking colonies. No liquefaction.

Broth cultures (37° C.).—No diffuse cloudiness, but minute fleecy particles scattered throughout the medium, giving it a somewhat granular appearance.

Litmus milk cultures (37° C.).—No visible change in 48 hours.

Remarks.—This microbe was unquestionably a streptococcus. Two mice were inoculated, each with 1 cc. of a three days' broth culture (37° C.). The animals remained apparently unaffected.

Experiment C.

325 grammes of the mud from the bed of N—— River were mixed with 325 cc. of sterile water. The mixture of mud and water was allowed to settle for a quarter of an hour. A portion of the comparatively clear liquid from near the surface was siphoned off, and this was used for the chemical and bacteriological examination.

A.—*Chemical Examination.*

Free ammonia	0·25	Parts per 100,000.
Albuminoid ammonia	0·9	
Oxygen absorbed from permanganate (four hours)	8·7	

B.—*Bacteriological Examination.*

The following results were obtained per cc. of liquid examined, 51,400 bacteria, and at least 100, but less than 1,000, spores of B. enteritidis sporogenes. ·1 cc. produced "gas" in a gelatine "shake" culture in 24 hours. A gas-forming coli-like microbe was isolated from $\frac{1}{1000}$ cc.

The following is a description of a streptococcus isolated from $\frac{1}{1000}$ cc.:—

Name.—Microbe XXI.—Streptococcus.

Source.—$\frac{1}{1000}$ cc. "washings" of 325 grammes mud (Experiment C.) of N—— River. Agar plate culture (37° C.).

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* Figure 25, Plate XXXVIII.

*Morphology.**—Stains well by Gram's method. Cocci in chains of short to medium length. An undoubted streptococcus.

Plate cultures (under a low power of the microscope) :—

Gelatine (20° C.) } Small, nearly circular, and transparent-looking colonies
Agar (37° C.) } with *clean* edge.

Gelatine "streak" cultures (20° C.).—Small, separate, transparent-looking colonies. No liquefaction.

Broth cultures (37° C.).—Diffuse cloudiness.

Litmus-milk cultures (37° C.).—No visible change in 24 hours. By second day strong acid and commencing clot formation.

Remarks.—Microbe XXI. was unquestionably a streptococcus. Two mice were inoculated subcutaneously, each with 1 cc. of a broth culture. The animals were apparently unaffected.

Experiments A, B, and C are not devoid of interest. They serve indeed to show the great importance of examining not only the water in a polluted river but the bed of the stream. For it must be remembered that every storm must create a disturbance in the bed of a stream, and so settled and possibly dangerous impurities may be carried as suspended matters for considerable distances.

From the point of view of this investigation the discovery of streptococci in $\frac{1}{1000}$ cc. of the "washings" from each of the three samples of polluted mud is of special interest.

Before taking leave of the subject, I may note that several of the streptococci which I obtained in the course of this investigation present a close correspondence in morphological or cultural characteristics, or in both, with well-known streptococci, such as S. brevis, S. pyogenes, and S. longus. I have, however, considered it advisable to refrain from drawing inferences as to the identity of the streptococci which I have recovered from water samples. In the present state of our knowledge much caution is needed in identifying them with particular micro-organisms which have been studied only in their association with normal secretions in the human subject, or with definite morbid processes. Until further study has been made in this direction, it appears to me at once more prudent and more convenient to deal with the indications that are afforded by the presence of streptococcus *as a class*, rather than to rely upon possibly misleading identification of particular varieties of microbes in that class.

CONCLUSION.

In conclusion, I would urge the importance of holding a clear conception of the kind of information really required in the bacterioscopic analysis of water.

In the first place, it is of primary import to possess full knowledge of the kind of bacteria, which may be present in water, that are to be thought of as essentially *of animal outcome.*

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* Figure 26. Plate XXXVIII.

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Secondly, it is desirable to obtain accurate knowledge of particular microbes liable to be found in water that are not only pathogenic or virulent in culture to animals, but are related in some way to morbid processes in the human subject.

Thirdly, it is desirable to draw a distinction between (*a*) bacterial tests which indicate quite recent and, therefore, presumably specially dangerous pollution; (*b*) other bacterial tests pointing to pollution less closely related to matters recently extruded by animals, but still not remote in character; and (*c*) bacterial tests which afford evidence of pollution which bears no necessary relation to the recent evacuations of animals, and, to this extent, is to be regarded as of relatively less importance, indicating potential rather than actual evil.

There can be no question that in point of delicacy, ease of application, and certainty of result no bacterial test hitherto discovered can be compared with the B. enteritidis sporogenes test of Klein. Moreover, this microbe is not only typical of excremental matters and virulent in cultures to animals, but is also seemingly causally related to certain cases of acute diarrhœa in the human subject. That it is absent from as much as 100 to 500 cc. of a pure water cannot be denied. That it is present in $\frac{1}{100}$ to $\frac{1}{1000}$ cc. of crude sewage is equally certain. Here, then, we have a microbe typical of excremental matter, and specially abundant therein, absent from pure waters, virulent in culture to animals, and possibly causally related to disease in the human subject. As a permanent record of past excremental pollution this test in our present state of knowledge has no equal, but, unfortunately, the fact of B. enteritidis sporogenes being a *sporing anaerobe* would seem to destroy the value of the test as evidence of *necessarily recent* pollution.

As regards B. coli the case is somewhat different. That certain strains of B. coli are pathogenic to man and animals is certain, but it must be admitted that B. coli as met with in nature outside the animal body is usually not conspicuous in this respect so far as may be judged by animal inoculations. This, however, does not destroy the value of the test as indicating fouling with objectionable matter, for in crude sewage B. coli (or closely allied forms) is habitually present, and in numbers usually exceeding 100,000 per cc. Yet in pure water this microbe (and its close allies) is altogether absent or present in insignificant proportion. It will not, I think, be denied by anyone that B. coli is extraordinarily abundant in the intestinal evacuations of animals. The question at issue is whether it can, under natural conditions outside the animal body, prolong its existence indefinitely. If it can, then the value of the test is seriously impaired, for this would mean that the demonstration of B. coli in a substance implied no necessary relation whatever to recent fouling, and might only mean the discovery of a microbe related by a long line of ancestry to the original objectionable intestinal stock. But, as a matter of actual observation, the *relative abundance* of B. coli in pure and impure substances is so amazingly different as to lead us to suspect that not only does B. coli not flourish in nature under ordinary conditions, but that it tends to soon lose its vitality and die. If, however, there is aught of truth in the records which I have collected during the last three years as regards the presence or absence of B. coli in soils and soil "washings," then it may be said with some measure of confidence that this intestinal microbe cannot prolong its existence indefinitely in soil, that on the contrary it soon tends to disappear, or becomes so altered as to be no longer recognisable as B. coli. For, in my experience, B. coli is not only absent or present in insignificant proportion in virgin soils, but is absent also from cultivated and manured soils *unless* the soils have been *recently* manured or *recently* polluted with matter of animal outcome. And the same is true, as I think, as regards waters, although possibly not to the same extent.

In brief, I am strongly of opinion that the presence of B. coli in any number, whether in soil or in water, implies *recent* pollution of animal sort.

But is there any microbe (or class of microbes) which by its presence implies animal pollution of *extremely recent*, and therefore *specially dangerous*, kind? The streptococci, in my judgment, are to be thought of in this sense. It cannot, I think, be without significance that I have failed to find streptococci in virgin soils and in pure water, and failed even in the case of polluted soils and waters when the contamination was not extremely recent in character. That I have found streptococci habitually present in crude sewage in $\frac{1}{1000}$ cc., present in human fæces in one milligramme, and present in minimal quantities of soils and water *recently polluted* with matters of animal outcome. It is true that none of the streptococci isolated, so far, have proved distinctly virulent to mice, and only a few of them have shown any pathogenic properties at all; but it does not follow from this that they would likewise be non-pathogenic to other animals, or that they were not derived from a previously pathogenic source. Nor does it impair the value of the test as an indication of recent fouling with objectionable matters. There may, of course, be streptococci occurring in nature which are not to be thought of as being immediately related to the intestinal evacuations of animals. But if this were the case, one would expect to meet these microbes in soil and water cultivations. Yet, as I have pointed out, streptococci seem to be absent from comparatively large quantities of pure water and virgin soils.

It will have been noted that in most of the experiments data are given referring to the amount of water required to produce "gas" in gelatine shake cultures. A brief note on the value of this test is given in Addendum B of this report.

In Addendum A a few experiments of a preliminary character are given, showing how numerous are streptococci of one or another sort in normal human fæces.

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ADDENDUM A.

PRELIMINARY NOTE ON THE BACTERIOLOGICAL EXAMINATION OF NORMAL HUMAN STOOLS AS REGARDS THE PRESENCE OF STREPTOCOCCI.

1. *Name.*—Microbe (A).
2. *Source.*—$\frac{1}{1000}$ gramme, normal stool 1. July 11, 1899. Agar plate culture (37° C.).
3. *Morphology.*—Stains by Gram's method. Cocci united together in short chains. Some of the elements bacillary in character.
4. *Gelatine plate cultures* at 20° C. (under a low power of the microscope, Leitz, 1 ocular, 3 objective).—No growth occurred; the experiment was repeated, but with the same negative result.
5. *Agar plate cultures* at 37° C. (under a low power of the microscope, Leitz, 1 ocular, 3 objectve.—Extremely minute colonies, showing coarse wavy granulation. Shape—irregular circles, with, at edge, separate loops of cocci, barely visible.
6. *Streak cultures* (gelatine at 20° C.).—A positive result could only be obtained by rubbing on the oblique surface of the gelatine a comparatively large amount of the growth. The colonies were excessively minute and transparent looking, and were barely visible to the naked eye. Growth was very slow and tardy. No liquefaction occurred.
7. *Broth cultures* at 37° C.—Diffuse cloudiness.
8. *Litmus-milk cultures* at 37° C.—No visible change, even after 10 days.
9. *Remarks.*—Microbe (A) was a streptococcus of feeble vitality. It grew hardly at all on gelatine at 20° C., and did not live very long in any of the cultures.

1. *Name.*—Microbe (B).
2. *Source.*—$\frac{1}{1000}$ gramme normal stool 1, July 11, 1899. Agar plate culture (37° C.)
3. *Morphology.*—Stains by Gram's method. Cocci united together in short chains.
4. *Gelatine plate cultures* at 20° C. (under a low power of the microscope, Leitz, 1 ocular, 3 objective).—Small transparent-looking colonies, showing faint granulation. Most of the colonies had a nucleated appearance. The edge of the colonies was *clean*, and showed no separate loops of cocci.
5. *Agar plate cultures* at 37° C. (under a low power of the microscope, Leitz, 1 ocular, 3 objective).—Colonies small and transparent-looking, with clean edge. Granulation very faint; no loops of cocci visible at periphery.
6. *Streak cultures* (gelatine at 20° C.).—Colonies small and roughly circular in shape. Colonies rather more opaque and perhaps slightly larger than is usually the case with streptococci. No liquefaction.
7. *Broth cultures* at 37° C.—Diffuse cloudiness.
8. *Litmus-milk cultures* at 37° C.—Strong acid and solid clot.
9. *Remarks.*—Microbe (B) was a streptococcus. One cc. of a two days' broth culture (at 37° C.) injected subcutaneously in a mouse produced a pathogenic result in five days, but no streptococci could be isolated from the spleen or kidneys of the animal. The fact of its clotting milk is of interest, because nearly all the streptococci met with in sewage and in polluted soils and water, although frequently producing acid, rarely clot the milk.

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On the Value of Examination of Water for Streptococci and Staphylococci with a view to detection of its Recent Contamination with Animal Organic Matter; by Dr. Houston.

1. *Name.*—Microbe (C).
2. *Source.*—$\frac{1}{1000}$ gramme normal stool 2. July 20th, 1899. Agar plate culture (37° C.).
3. *Morphology.*—Stains by Gram's method. Chains of cocci (?) of medium length. The elements, however, are lengthened out, making it difficult to say whether the microbe is a streptococcus showing bacillary formation or a bacillus simulating a streptococcus.
4. *Gelatine plate cultures* at 20° C. (under a low power of the microscope, Leitz, 1 ocular, 3 objective).—Small transparent colonies, markedly irregular in shape. Wavy granulation distinct. At the periphery of the colonies loops clearly visible, but these seem to be composed of a number of rows running side by side.
5. *Agar plate cultures* at 37° C. (under a low power of the microscope, Leitz, 1 ocular; 3 objective).—Small, very irregularly-shaped colonies, with well-marked wavy granulation. At the edge of the colonies loops clearly visible.
6. *Streak cultures* (gelatine at 20° C.).—Small transparent colonies of irregular shape and granular appearance. No liquefaction.
7. *Broth cultures* at 37° C.—Diffuse cloudiness, and to some extent flocculent cloudiness as well.
8. *Litmus-milk cultures* at 37° C.—No visible change.
9. *Remarks.*—It was difficult, indeed, almost impossible, to determine whether microbe (C) was a streptococcus showing bacillary formation or a bacillus simulating a streptococcus.

1. *Name.*—Microbe (D).
2. *Source.*—$\frac{1}{1000}$ gramme normal stool 2. July 20th, 1899. Agar plate culture (37° C.).
3. *Morphology.*—Stains by Gram's method. Cocci occuring in masses, but also as short chains.
4. *Streak cultures* (gelatine at 20° C.).—White, more or less confluent, opaque growth. Later, liquefaction.
5. *Broth cultures* at 37° C.—Abundant diffuse cloudiness.
6. *Litmus-milk cultures* at 37° C.—By second day, strong acid and solid clot.
7. *Remarks.*—Microbe (D) was evidently a staphylococcus. Possibly akin to staphylococcus albus.

1. *Name.*—Microbe (E).
2. *Source.*—$\frac{1}{1000}$ gramme normal stool 3. July 25th, 1899. Agar plate culture (37° C.).
3. *Morphology.*—Stains by Gram's method. Cocci united together to form short chains.
4. *Gelatine plate cultures* at 20° C. (under a low power of the microscope, Leitz, 1 ocular, 3 objective).—Minute transparent, nearly circular colonies, showing wavy granulation. The edge of the colonies are usually smooth, but may present a slightly-frayed appearance. Some colonies are nucleated.
5. *Agar plate cultures* at 37° C. (under a low power of the microscope, Leitz, 1 ocular, 3 objective).—Minute transparent colonies, showing wavy granulation. The colonies are usually circular, with *clean* edge, but some of the smaller ones are irregular in shape, and these show an appearance suggestive of "loops" towards the periphery.
6. *Streak cultures* (gelatine at 20° C.). Minute transparent colonies. No liquefaction.
7. *Broth cultures* at 37° C.—Abundant diffuse cloudiness.
8. *Litmus-milk cultures* at 37° C.—Acidity, but no clot.

9. *Remarks.*—Microbe (E) was a streptococcus. 1 cc. of a two days' broth culture (37° C.) was injected subcutaneously in a mouse. The animal died on the second day, but the spleen was not enlarged, and the other organs appeared healthy. No cultures were made.

1. *Name.*—Microbe (F).
2. *Source.*—$\frac{1}{1000}$ gramme normal stool 3. July 25th, 1899. Agar plate culture (37° C.).
3. *Morphology.*—Stains by Gram's method. Cocci united together to form short chains.
4. *Gelatine plate cultures* at 20° C. (under a low power of the microscope, Leitz, 1 ocular, 3 objective).—Small transparent colonies, with *clean* edge, circular in shape, and showing faint wavy granulation.
5. *Agar plate cultures* at 37° C. (under a low power of the microscope, Leitz, 1 ocular, 3 objective).—Minute transparent colonies, with firm edge. The colonies are circular in shape, and show only very faint wavy granulation.
6. *Streak cultures* (gelatine at 20° C.).—Small transparent, slowly-growing colonies.
7. *Broth cultures* at 37° C.—Abundant diffuse cloudiness.
8. *Litmus-milk cultures* at 37° C.—In 24 hours, distinct acid, but no clot. By three days, solid clot.
9. *Remarks.*—Microbe (F) was a streptococcus. A mouse injected subcutaneously with 1 cc. of a two days' broth culture (37° C.) died, but not until the tenth day, and no streptococci could be isolated from its organs.

1. *Name.*—Microbe (G).
2. *Source.*—$\frac{1}{1000}$ gramme normal stool 3. July 25th, 1899. Agar plate culture (37° C.).
3. *Morphology.*—Stains by Gram's method. Cocci united together to form short chains. The chains appeared to be longer than in the case of microbe (E).

4, 5, 6, 7, and 8. *Gelatine and agar plate cultures, gelatine streak cultures, broth and litmus milk cultures.*—Could not with certainty be distinguished from microbe (E) in above cultures.

9. *Remarks.*—Microbe (G) was a streptococcus. A mouse inoculated subcutaneously with 1 cc. of a two days' broth culture died on the sixth day but no streptococci could be isolated from its organs.

ADDENDUM B.

NOTE ON THE PRODUCTION OF "GAS" IN GELATINE "SHAKE" CULTURES.

In most of the preceding experiments it will be noted that the smallest amount of water capable of producing "gas" in gelatine "shake" cultures at 20° C. was determined.

The gas-producing property of certain bacteria has been for long utilised as a test in one way or another by different bacteriologists. The sense in which I would here advocate this test may be briefly outlined as follows :—

From a long series of experiments I have found that in sewage B. coli (or closely allied forms) and a microbe, which I have described under the name of "sewage proteus," are present in crude sewage in numbers usually exceeding 100,000 per cc. This "sewage proteus" (and its close allies), just like B. coli, produces "gas" in gelatine "shake" cultures in 24 hours at 20° C. It is evident, then, that it might be anticipated that the addition of sewage *directly* to gelatine would produce "gas" in "shake" cultures provided that these microbes were present in sufficient numbers. Such a biological test could hardly be considered scientific in the absence of records to show (*a*) that the most numerous gas-forming bacteria in sewage belong to the objectionable coli and proteus class, and (*b*) that a parallelism exists between the numbers of B. coli and sewage proteus and the amount of liquid required to produce a gaseous change.

In my experience both these things are true, although it is to be noted that a larger quantity of sewage is required to form "gas" when added directly to the gelatine than the actual number (as ascertained by plate culture) of B. coli and B. proteus would lead one to expect. As a matter of fact the test is about 100 times less delicate (although still very delicate) than the enumeration of B. coli and B. proteus by plate culture. Usually about $\frac{1}{1000}$ cc. of sewage is required to produce "gas" in gelatine "shake" culture in 24 hours at 20° C., whereas, as has been stated, gas-forming B. coli and B. proteus are commonly present in $\frac{1}{100000}$ cc. of sewage. So that the absence of "gas" in 24 hours in gelatine (at 20° C.), to which, say, $\frac{1}{1000}$ cc. of sewage had previously been added, would not imply the absence of the microbes from this amount of sewage, but only that they were not present in sufficient numbers to produce a visible development of "gas." The test may be rendered more delicate by extending the time up to 48 hours or even longer, but I have not, for various reasons, found this advisable unless when dealing with potable waters, and when the result is *negative* in 24 hours. Although unquestionably, in my experience, there is a broad parallelism between the number of B. coli and B. proteus in a substance and the amount of that substance necessary to effect a gaseous change in gelatine, it must not be supposed that the agreement is an absolute one. Yet such discrepancies as do occur need not be regarded as so pronounced as to seriously impair the value of the test as a "rough and ready" biological method of comparing different substances in respect of these objectionable bacteria.

It has been stated that $\frac{1}{1000}$ cc. of sewage is usually sufficient to produce "gas" in gelatine "shake" cultures in 24 hours at 20° C. As regards other substances, so far as my experience goes, comparatively large quantities of virgin soils do not produce this gaseous change, whereas a *minimal* quantity of a soil recently polluted yields a positive result. As regards waters, it may be said that 1 cc. of a *pure* water never gives rise to "gas" formation under these conditions, and very frequently the bacterial contents of a much larger quantity (obtained by the "filter-brushing" method) also yields a negative result. In the case of polluted waters the results depend on the nature and degree of the pollution, and whether it is recent or remote in character. As a rapid and simple method of forming an opinion of the extent to which biological purification has been carried in the case of polluted rivers and sewage effluents the test is one of considerable value.

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On the Value of Examination of Water for Streptococci and Staphylococci with a view to detection of its Recent Contamination with Animal Organic Matter; by Dr. Houston.

As regards the best method of applying this test, I strongly recommend the following procedure:—

In the case of sewage, sewage effluents, and polluted waters, make a series of dilutions, each containing one-tenth less of the liquid than the one immediately above it in the scale of dilutions. For example, if the liquid be raw sewage, proceed as follows:—Place 90 cc. of water in each of five flasks (1, 2, 3, 4, 5) and sterilise. Add 10 cc. of sewage to 1. Add 10 cc of 1 to 2; 10 cc. of 2 to 3; 10 cc. of 3 to 4; and 10 cc. of 4 to 5. Next add severally to each of six 10 cc. gelatine tubes 1 cc. of sewage direct 1 cc. of 1; 1 cc. of 2; 1 cc. of 3; 1 cc. of 4; and 1 cc. of 5 dilutions. Melt the gelatine, and make "shake" cultures, and when the gelatine has become solid incubate at 20° C. In such an experiment the result in 24 hours as regards "gas" formation would be likely to be as follows:—

1 cc. direct	1 cc. of 1 (·1 of sewage)	1 cc. of 2 (0·1 of sewage)	1 cc. of 3 (·001 of sewage)	1 cc. of 4 and (·0001 of sewage)	1 cc. of 5 (·00001 of sewage)
+	+	+	+	—	—

That is, $\frac{1}{1000}$ cc., but not $\frac{1}{10000}$ cc. sufficed to produce "gas" in gelatine "shake" culture in 24 hours at 20° C.

In the case of potable waters, it is advisable to filter 1,000 cc. of the sample through a sterilised Pasteur filter, and to brush the outside of the candle with a sterile brush into 10 cc. of sterile water. Next add severally to each of four 10 cc. gelatine tubes 1 cc. of the sample direct; 0·1 cc. of the sample direct; 1 cc. of the "filter brushing" suspension (= the bacterial contents of 100 cc.); and 0·1 cc. of the "filter brushing" suspension (= the bacterial contents of 10 cc.). Melt the gelatine and make "shake" cultures in the ordinary way.

There is some reason to suppose that B. coli and B. proteus outside the animal body and under natural conditions may in course of time lose their original gas-producing property, or retain the ability in diminished degree. But if this be true is it not also probably the case that they and other correlated germs of excremental sort are the less to be thought of as noxious or dangerous in character by reason of loss of their original properties as the result of a too long separation from their initial animal surroundings?

No. 4.

APP. B, No. 4.

On the Chemical and Bacteriological Examination of "Washings" of Soils; by Dr. Houston.

REPORT on the CHEMICAL and BACTERIOLOGICAL EXAMINATION of the "WASHINGS" of SOILS with reference to the AMOUNT and NATURE of the ORGANIC MATTER and the NUMBER and CHARACTER of the BACTERIA contained in them; by Dr. A. C. HOUSTON.

This report is to be regarded as an extension of last year's work (App. B, No. 5, 1898–9), just as last year's was an amplification of the previous year (App. B, No. 2, 1897–8).

It will not be amiss to summarize as briefly as possible the contents of these reports.

Summary of Report on the Chemical and Bacteriological Examination of Soils (App. B, No. 2, 1897-8).

The soils (21 in number) were obtained from a plurality of sources, *e.g.* sandy soils; polluted and virgin soils; garden soils; soils from moorland and pasture land; soils rich in animal organic matter, and soils rich in decaying vegetable matter.

Chemically, the soils were examined for the amount of (*a*) free ammonia; (*b*) albuminoid ammonia; and (*c*) oxygen absorbed from permanganate.

Bacteriologically, the soils were tested for (*a*) total number of bacteria; (*b*) spores of äerobic bacteria; (*c*) kinds of bacteria, and especially for (*d*) B. coli and (*e*) spores of B. enteritidis sporogenes.

The *chemical results* went far to indicate that soils rich in inorganic matter, poor in vegetable organic matter, but grossly polluted with animal excremental matters might yield on chemical examination much lower results than soils poor in inorganic matter, rich in vegetable organic matter, but free from all sources of objectionable animal pollution. Considered from the epidemiological point of view it was apparent that the "washings" from some of the soils which were known to have been grossly polluted with matter of highly objectionable sort might contaminate a water supply, and yet be hardly if at all appreciable to chemical tests, even when added in considerable amount. Whereas the "washings" of other soils (soils peculiarly rich in vegetable organic matter, but virgin in the sense of absence of animal excremental matter) gaining access to a water supply even in small proportion might so alter the composition of the water as to lead the chemist to pronounce unfavourably on the sample. That chemistry can give some indication as to whether organic matter is chiefly of vegetable or of animal origin may be admitted, but it can hardly be denied that the means of distinguishing are largely conjectural in character. And chemistry (as ordinarily applied to the chemical analysis of water) is powerless to differentiate between the various and complex kinds of organic matter and their proportions relative to the sum of organic matter present, and is further incompetent to appreciate an amount of organic matter small in itself but important none the less in its biological significance.

The *bacteriological results*, if not wholly satisfactory or conclusive, were of a distinctly encouraging nature.

Thus, as regards the *total number of bacteria*, an example may be given by way of illustration. Four virgin sandy soils yielded on an average less than 100,000 microbes per gramme; whereas two soils known to have been recently and grossly polluted with sewage, contained 26 and 115 million micro-organisms respectively in a similar amount. Further, the virgin soils (other than sandy soils) contained on an average 914,000 bacteria per gramme, and the garden soils (other than one recently polluted with human excrement), 1½ million.

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Previous to this report, the estimation of the *number of spores* of aerobic bacteria (both the actual number and the number relative to total bacterial flora inclusive of spores) in soils had apparently received little or no attention from bacteriologists. It was shown in the report that the number of spores in soils was very remarkable, and that the number relative to the total number of microbes present was equally striking. Thus, one soil contained 570,819 spores per gramme, and the lowest number in any soil was 1,315. As regards the number relative to the total number of bacteria, the ratios commonly lay between 1 to 2 and 1 to 10, although occasionally the number of spores in relation to the total bacterial flora was less. These figures are in marked contrast to the number (actual and relative) usually found in sewage. In sewage (speaking from a large number of determinations) the number of spores is commonly only 200-500, with a total bacterial flora of 1 to 10 or more million bacteria respectively per cc. In water the number is always very small, both actually and relatively, except when storm water gains access to the supply in considerable amount; when there is a decided increase in the number of spores and in their number relative to the total number of germs.

The predominant sporing microbe met with in the cultures was B. mycoides, but B. subtilis (and allied forms) and B. mesentericus (and its allies) were likewise commonly present. In three of the soils the number of spores of B. mycoides was 4,000, 5,000, and 40,000 per gramme. It was suggested in the report that the entrance into a water supply of "flood" water, especially from cultivated soils, might be capable of being readily appreciated by the increase in the number of spores and in particular of spores of B. mycoides.

As regards *the sorts of bacteria* found in the soil cultures, notes were given not only of the number but approximately of the relative abundance of a number of microbes. For example, B. mycoides was usually present in great abundance, and in eleven of the soils the average number was 32,000 per gramme.

Another micro-organism very prominent in the soil cultures was the bismarck-brown cladothrix of soil. Thus in nine of the soils the average number was 34,000 per gramme.

Further notes were given in the report as regards the presence and relative abundance in the soil of a variety of other microbes.

Passing next to the consideration of the presence or absence of *B. coli* in the soils, the following results were obtained:—

In each case ½ gramme of soil was added to phenol broth, and the tube incubated at blood heat. If no diffuse cloudiness showed itself in 24 hours, it was properly assumed that B. coli was not present. When diffuse cloudiness appeared surface phenol gelatine plate cultures were made from the broth. Colonies resembling B. coli were next subcultured in broth for diffuse cloudiness (and indol reaction); in gelatine "shake" culture for "gas" formation; and in milk for acidity and clotting. Of the 21 original broth cultures three soils (one virgin peat and the other two virgin sandy soil) failed to produce uniform turbidity in broth culture, so their further study was abandoned. From the remaining 18 broth cultures phenol gelatine plate cultures were made. In five of the gelatine plates there were no colonies at all resembling B. Coli. These corresponded to a garden soil, a virgin sandy soil, a pasture soil, a virgin peaty soil, and an orchard soil. In two other plates colonies developed sufficiently like B. coli to merit subculture, and in the remainder colonies resembling B. coli so closely as not to be capable of being differentiated therefrom without making further tests. By the further tests of subcultures in broth, gelatine "shake," and milk, seven soils yielded positive results. Of these, however, one slowly liquefied the gelatine and gave no indol, two others gave no indol, and one very slight indol. Of the other soils three gave an atypical cloudiness in broth, no indol, no gas, slow liquefaction of gelatine, and no acid clotting of milk. Another yielded the same results except that no liquefaction of gelatine occurred. Yet another gave diffuse cloudiness in broth, very faint indol reaction, no gas and slow liquefaction in gelatine shake culture, and no acid clotting of milk. The remaining soil gave diffuse cloudiness in broth, very faint indol, no gas and liquefaction in gelatine shake culture, but acid clotting of milk. Instead of entering into a description of the characters of the above soils it is convenient to quote the conclusions stated in the report.

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"It appears that, *quâ* B. coli, some soils yielded complete or partial evidence of pollution with excrement when perhaps they might have been expected to yield negative results, and others gave negative, or partially negative results, where they might have been expected to give positive results. Nevertheless, on the whole, the experiments go to show that pure soils, as compared with contaminated soils, do not contain the B. coli or its close allies." . . . . . . "It has been said that the experiments, judged as a whole, go to show that virgin soils, as compared with polluted soils, do not contain B. coli or its close allies; and it may be anticipated that the 'surface washings' from virgin soils, as compared with soils 'dressed' with manure or polluted with excremental matter, would show an important bacteriological difference in this respect—that, in fact, the 'surface' water from soils gaining access to waterworks, might be judged objectionable or free from positive evidence of danger, by the examination of the water for B. coli and closely allied forms."

As regards *B. enteritidis sporogenes*, all the soils were tested quantitatively for the number of spores of this pathogenic anaerobe. Without entering into detail it may be said that the results were of an encouraging nature, and showed that generally speaking there were no spores of this microbe in as much as 10 mgrms. of virgin soil (*e.g.* soils from moorland and sandy soils), whereas in soils which at *one time or another* had been contaminated with excremental matters the number of spores ranged usually from 1,000 to 10,000 per gramme.

"The spores of B. enteritidis are not present in *pure* waters, and it is evident from the above results that they are very numerous in polluted and in cultivated soils, and absent (or nearly so) in *pure* soils. It is more than probable, then, that pollution of drinking water with 'surface' water from an objectionable source might readily be ascertained bacteriologically by the discovery in the water of these spores, even in cases where chemical analysis failed to show evidence of such pollution. It is true that discovery of them in the water would not prove that the pollution was directly due to surface drainage from soil, because crude sewage contains the spores of B. enteritidis in great numbers; but whether derived from the direct pollution of water with sewage, or indirectly from the pollution of soil with sewage, or from the manuring of land with animal excrement, their presence in a water indicates contamination from an objectionable source."

In concluding this summary it will not be out of place to quote the last few sentences of the report, as they serve to point out the reason why, in further work on this subject, the "washings" of the soils were examined. "The general tendency of this soil enquiry is to encourage research having for its object the parallel examination, chemical and bacteriological, of the 'washings' from surface soils, and more particularly those soils which are to be thought of as dangerous adjuncts to water supplies. Judging by the results which have been obtained in this enquiry, such a research seems to promise definite information as to how far chemistry and how far bacteriology can be relied on to detect dangerous contamination of water through the medium of soil. There would seem to be more than an indication that though chemistry might fail in certain cases, dangerous pollution could, in most instances, readily be demonstrated by modern bacteriological methods."

Summary of Report on the Chemical and Bacteriological Examination of the "Washings" of Soil (App. B, No. 5, 1898–9).

Ten soils were obtained from diverse sources, for example, from meadow and pasture land; from a sewage field; from peaty moorland; from a garden and from the banks of polluted rivers.

The washings were obtained in the following way:—

"Ten grammes of soil, weighed in a sterile watch glass, were transferred to a sterile mortar, bruised, and carefully mixed with 100 cc. of pure sterile distilled water. After leaving for a quarter of an hour, so as to allow the grosser particles of various sorts to settle, 50 cc. of the mixture of soil and water were decanted into a sterile glass cylinder (9″ by 1″). After a quarter of an hour 10 cc. of the mixture were drawn off from near the surface with a sterilised 10 cc. pipette, and placed in a sterile vessel. 990 cc. of pure sterile distilled water were next added, so as to bring the total bulk of soil and water to 1,000 cc. This 1,000 cc. was called "soil water," I., II., III., &c., as the case might be, and it was subjected to the chemical and bacteriological tests."

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Chemically, the soil waters were examined for free and albuminoid ammonia and oxygen absorbed from permanganate.

Bacteriologically, the soil waters were examined for the total number of bacteria, the number of spores of aerobic bacteria, and the kinds of bacteria, and more especially for B. coli, spores of B. enteritidis sporogenes, and streptococci.

The chemical results bore out the provisional inferences stated in App. B., No. 2, 1897-8, and showed that the "washings" of soils, even when added to water in considerable amount, do not very greatly alter the composition of the liquid in respect of organic matter. Moreover, it was found that notwithstanding the *widely different* character of the soils of experiment, the percentage deviations from the mean of the analyses of all the samples, as regards free ammonia (from +54 and to −48), albuminoid ammonia (+ 35 and −38), and oxygen absorbed from permanganate (+ 158 and −75), were not of so great magnitude as to allow differential conclusions to be drawn as to the degree of pollution of the several soil samples. Further, it was apparent that some of the washings from virgin soils rich in vegetable organic matter and poor in animal organic matter and inorganic substances yielded much higher results than polluted soils rich in animal organic matter of highly objectionable sort and in inorganic substances, but poor in vegetable organic matter. Lastly, the results showed clearly that chemistry, by the processes ordinarily in use in water analysis, can hardly be relied on to detect the presence of "flood water" otherwise than when present in great amount; is quite incapable of appreciating an amount of the washings from a soil recently and heavily fouled with excremental matters which would be considered gross by the bacteriologist: and entirely fails to draw a satisfactory distinction between soils which are to be thought of as harmless and those that are indubitably dangerous.

The bacteriological results on the other hand were distinctly encouraging, and showed that not only could "flood water" (from surface soils) entering a water supply be recognised as such, but its previous relation to objectionable pollution (recent as well as remote) could likewise be demonstrated.

As regards the *total number of bacteria*, these owing to their enormous number could not be counted in the plates made from the washings of Soil I. (from a sewage field). Other soils conspicuous as regards number of microbes in the washing were a manured pasture soil (2,280 in 1 cc.), and mud from the bank of the polluted Brent and Thames rivers (3,470 and 2,200 respectively in 1 cc.). The smallest number of micro-organisms was found in the case of a virgin peaty soil, namely, 211 per cc.

Considering next the number of *spores of aerobic bacteria* the results confirmed those obtained in 1897–8, and showed that the actual number of spores and their number relative to the total bacterial flora in the "soil waters" was very great. In six of the soils the ratio of spores to total microbes was 1:5; 1:4; 1:2; 1:1·2; 1:1·8; and 1:2·4. In all the soil waters the number of spores both actually and relatively to the total number of bacteria was far in excess of the number found in potable waters. Potable waters, that is, under ordinary conditions of rainfall, for the contention is that during "storms" the "washings" from soils gaining access to a water supply would tend to increase the number of spores (actually and relatively to the total bacterial flora) materially.

As to the *sorts of bacteria* found in the cultures, attention was again drawn to the number of cladothrix in the "soil waters," and also to the number of B. mycoides and its spores. As regards the latter microbe, two micro-photographs were shown in the report illustrating in the most striking manner the remarkable number of B. mycoides (as bacilli and spores) which may be present in a soil. Another micro-organism not indeed peculiar to soil, but characteristic in the sense of being usually present there in great abundance, is the *granular bacillus* (App. B, No. 2, 1897–8). This bacillus was specially noticeable in the *surface* gelatine plate cultures of the "soil waters." Notes were also given of the occurrence of other bacteria in the soils, *e.g.*, varieties of B. mesentericus; B. fluorescens liquefaciens; B. fluoresencens non-liquefaciens, varieties of B. subtilis, &c.

Turning next to the important records of the presence or absence of *B. coli* in a definite quantity (0·1 cc.) of the various "soil waters," it is to be specially noted

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that in five of the soils a negative result was recorded. These soils were:—a garden soil at one time heavily manured, but not recently; a meadow soil yearly manured; a virgin pasture soil; Thames mud above the intake of the East London Waterworks Company; and a virgin peaty soil. As regards the remaining five soils, colonies appeared in the plate cultures sufficiently like B. coli to merit subculture. Of these, two were readily discarded because one grew with great difficulty at blood heat (pasture soil, last manured three years previously), and the other because it produced early liquefaction of the gelatine (mud from bank of river Colne). Another suspected B. coli (corresponding to Thames mud at Blackfriars) was only doubtfully allied to B. coli, since it gave no indol (5th day), no "gas" in "shake" culture, and no clot (5th day) in milk. The remaining two (corresponding to soil taken from a sewage field and mud from the bank of the polluted river Brent) were sufficiently like B. coli to allow of a positive diagnosis. These results coupled with those obtained during the previous year's work suggested that B. coli is absent (speaking in the comparative sense) from pure soils and may be absent also from polluted soils unless the contamination is of *recent* sort. Yet it were wise to guard this statement with the further remark that B. coli may conceivably remain viable in soils but become so altered in its morphological and biological characters as to be no longer recognizable. Considering the enormous total number of bacteria in soils (rarely less than 1 million per gramme), the fact is quite remarkable that whereas in sewage B. coli (or closely allied forms) can readily be isolated from so minute a quantity as $\frac{1}{100000}$ cc., yet in impure soils, other than those *freshly* and grossly fouled with excremental matters, it is absent or present in small number.

The results as regards *spores of B. enteritidis sporogenes* may be summarised briefly as follows:—Anaerobic milk cultures were made in each case with $\frac{1}{10}$ cc. and 1 cc., and usually also with 2 cc. "soil water." Only one soil (from a sewage field) yielded a positive result with 0·1 cc. "soil water." Of two pasture soils, one (manured) contained B. enteritidis in 1 cc., and the other (not manured) yielded a negative result with a similar quantity of "soil water." Again, Thames mud high up the river contained the spores of this microbe in 2 cc., but not in 1 cc., whereas the mud collected much lower down the river yielded a positive result with the 1 cc. culture. A virgin peaty soil contained no spores of B. enteritidis even in 2 cc. of "soil water." Mud from the banks of the polluted Colne and Brent rivers yielded a positive result in each case with 1 cc.

These results, especially if taken in conjunction with those already summarised, suggest that the spores of B. enteritidis sporogenes are absent, or present in small number only, in virgin soils, and present in enormous numbers in polluted soils, although not necessarily soils *recently* contaminated.

Passing next to consideration of the results obtained as regards *streptococci* the following points are worthy of note. A negative result was obtained in the case of seven soils (virgin or *not recently* polluted) and a positive result with three soils. The latter soils were known to have been subject to *recent* pollution of excremental sort, namely, soil from a sewage field and mud from the banks of the polluted Thames (at Blackfriars) and Brent (near Hendon) rivers. In brief, streptococci were not found in the virgin or not freshly polluted soils, and were present in those soils recently contaminated with objectionable animal matters. In conclusion, it may not be amiss to quote a few sentences from the report to show the importance of the subject:—

'These results must be considered not unimportant if streptococci (*as a class*) are derived from the intestinal tract, and tend, outside the animal body, not only not to multiply, but to rapidly lose their vitality and to die. Their presence would seem to indicate *recent* and *objectionable* pollution. Of course there may be exceptions to the rule; *e.g.*, some streptococci may be able to multiply in nature outside the animal body, while others may be peculiarly resistant, and so avoid extinction when the conditions are unfavourable. Again, there may be streptococci in nature which do not owe their origin to excremental matter. However this may be, detection of streptococci in polluted soils, and failure to detect them in non-polluted soils, is of interest in view of the circumstance that, as a result of examination of a large number of samples of crude sewage and effluents from biological filters, I have found streptococci present in great numbers (1,000 or more per cc.) in such material. . . ."

This year's work consisted in the parallel examination, chemical and bacteriological, of the "washings" of soil. It may thus be regarded as an extension of the work carried out during the previous year. There was this difference, however, namely, that the soils were carefully chosen so as to come more distinctly than in the previous year under one or other of the two headings of *Virgin soils* and *Grossly polluted soils*. Further, in the case of the polluted soils, the "washings" used in the bacteriological (but not in the chemical) examination were diluted one hundred times.

The following is a summary of the several sections of this report :—

A. Description of the samples of soil.

B. Description of the method used in obtaining "washings" of the various soils.

C. Description of the chemical and bacteriological methods adopted in the investigation.

D. Results of chemical examination of "soil waters."

(*a.*) Free ammonia.

(*b.*) Albuminoid ammonia.

(*c.*) Sum of the ammonias (free and albuminoid).

(*d.*) Oxygen absorbed from permanganate.

E. Results of bacteriological examination of "soil waters."

(*a.*) Total number of bacteria.

(*b.*) Spores of aerobic bacteria.

(*c.*) Results as regards the presence of B. coli.

(*d.*) Results as regards the presence of spores of B. enteriditis sporogenes (Klein).

(*e.*) Results as regards the presence of streptococci.

A.—*Description of the samples of soil used in the investigation.*

I. *Sewage field.* "Treated" with sewage for some months previous to collection. Last application of sewage 14 days previously. At Epsom.

II. *Sewage field.* Heavily "treated" with sewage for some months previous to collection. Last application of sewage 10 days previously. At Nottingham.

III. *Sewage field.* Intermittently "treated" with sewage for some months previous to collection. Before the sewage was applied to the land it was steam-ploughed; antecedent to this it raised a crop of oats. The land had last been "treated" with sewage on the day before collection, but on this date there were heavy floods. At Croydon.

IV. *Sewage field.* From the same farm as the last sample, but from a different plot: namely, an arable field fallow for some months. Sewage applied intermittently and sometimes continuously and land usually overworked. Last application of sewage less than 24 hours previous to collection.

V. *Virgin soil.* A sandy pasture soil. Near Colchester.

VI. *Virgin soil.* A peaty soil from moorland at Swarthmoor, Austwick.

VII. *Thames mud.* The sample was collected at Barking at low tide, and was polluted both by the river and more especially by the sewage effluents from the outfall works in that region.

VIII. *Virgin soil.* From a wood rich in vegetable matter. Soil somewhat peaty in character. Tarn Wood, near Giggleswick.

IX. *Virgin soil.* From pasture land. Giggleswick.

X. *Brent mud.* From the bank of the polluted river Brent, about 100 yards below where the effluent from Hendon sewage works enter. Near the water's edge.

XI. *Virgin soil.* From a wood. Main's Wood, Giggleswick.

XII. *Virgin soil.* A peaty soil from moorland. Near Long Preston.

XIII. *Virgin soil.* A sea-shore sand collected above high water mark. Near Bognor.

XIV. *Sewage field.* The sample was collected from a spot still moist from the application of sewage shortly before the time of collection. At Settle.

XV. *Virgin soil.* High pasture land. Giggleswick Scaurs.

It is to be noted that soils I., II., III., IV., VII., X., and XIV. were all *grossly polluted.* Of these, I., II., III., IV., and XIV. were from sewage fields, and VII. and X. consisted of mud from the banks of the polluted Thames and Brent rivers. Soils V., VI., VIII., IX., XI., XII., XIII., and XV., on the other hand, were all virgin soils.

Of these, VI. and XII. were collected from peaty moorland; V., IX., and XV. from pasture land; XIII. sand from the sea-shore above high water mark; and VIII. and XI. from woods.

B.—*Description of the method used in obtaining "washings" of the various soils.*

The washings of the soils were, in each case, obtained in the following way:—

> 10 grammes of soil, weighed in a sterile watch glass, were transferred to a sterile mortar, bruised, and carefully mixed with 100 cc. of pure sterile distilled water. After leaving for a quarter of an hour, so as to allow the grosser particles of various sorts to settle, 50 cc. of the mixture of soil and water were decanted into a sterile glass cylinder. After a quarter of an hour, 10 cc. of the mixture (hereafter in report termed *strong soil water*) were drawn off from near the surface with a sterilized 10 cc. pipette, and placed in a sterile vessel. 990 cc. of pure sterile distilled water were next added so as to bring the total bulk of soil and water to 1,000 cc. (hereafter termed *medium soil water*). 10 cc. of this mixture in the case of the polluted soils were added to 990 cc. of pure sterile distilled water to form a further mixture (hereafter termed *dilute soil water*) one hundred times weaker than the medium soil water.

It is especially to be noted that for the *chemical tests* in all the experiments the *medium soil water* was used; that for the *bacteriological* tests the *medium soil water* was used in the case of the virgin soils (in one instance the *strong soil water* was also employed), and the *dilute soil water* in the case of the polluted soils (in one instance the *medium soil water* was likewise used).

C.—*Description of the chief chemical and bacteriological methods adopted in investigating the various soil waters.*

(A.) Chemical methods:—

> The "soil waters" were examined for (1) *free ammonia*, and (2) *albuminoid ammonia* (by Wanklyn's process), and also for (3) *oxygen absorbed from permanganate.*

The methods adopted were the same as those used in 1898–9 (App. B, No. 5), except that the estimation of the amount of oxidisable matter was made at the room temperature and for four hours, instead of at 100° C. for one hour. As these processes are so well known and were fully described in last year's Report, it is unnecessary to enter into further detail. As already said the *medium soil water* was employed in *all the chemical tests.*

(B.) Bacteriological methods:—

> The "soil waters" were examined for (1) *total number* of bacteria; (2) *spores of aerobic bacteria*; (3) B. *coli communis*; (4) B. *enteritidis sporogenes* (Klein); and (5) *streptococci.*

The methods used were described in detail in last year's Report (App. B, No. 5), and it is only necessary to add that in the case of the polluted soils the dilute soil water (usually 1,000 cc.) was filtered through a sterilized Pasteur filter, and the candle brushed with a sterile brush into 10 cc. of sterile water. Each cc. of the "filter brushing" represented approximately the particulate matter (and consequently the bacterial contents) of 100 cc. of the dilute soil water.

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D.—*Results of the chemical examination of fifteen soils as regards the amount of organic matter in the "washings" (soil waters) from each sample.*

TABLE I.

Showing the results of Chemical Examination of Fifteen Soils, obtained from various sources, as regards the amount of Free and Albuminoid Ammonia, and Oxygen absorbed from Permanganate, in the "washings" (*medium soil water*) from each sample. Results stated as parts per 100,000.

Experiment.	Description of the sample of soil. (1)	Free Ammonia. (2)	Albuminoid Ammonia. (3)	Sum of the ammonias, free and albuminoid. (4)	Oxygen absorbed from permanganate (4 hours). (5)
1	Soil I. Sewage field	·0134	·0234	·0368	17
	" II. " "	·0153	·022	·0373	·161
3	" III. " "	·0187	·0434	·0621	·138
4	" IV. " "	·0187	·0234	·0421	·159
5	" V. Virgin soil (sandy soil from pasture).	·0134	·016	·0294	·06
6	" VI. Virgin soil (peaty soil from moorland).	·0047	·06	·0647	1·484
7	" VII. Thames mud (near Barking, at low tide).	·0248	·02	·0448	·115
8	" VIII. Virgin soil (from a wood)	·0134	·0134	·0268	·201
9	" IX. Virgin soil (from pasture) .. .	·0087	·017	·0257	·05
10	" X. Brent mud (about 100 yds. below Hendon Sewage Works).	·007	·02	·027	·152
11	" XI. Virgin soil (from a wood)	·008	·034	·042	·258
12	" XII. Virgin soil (peaty soil from moorland).	·007	·0834	·0304	·761
13	" XIII. Virgin soil (sand from sea-shore)	·0034	002	·0054	·269
14	" XIV. Sewage field	·01	·02	·03	·178
15	" XV. Virgin soil (high pasture land) ..	·0134	·1	·1134	·756

In considering the chemical results the following points are to be noted :—

(*a*) *Free ammonia* (Col. 2, Table I).—The average amount of free ammonia in the 15 soil waters was ·01199. The largest amount was found in Soil VII. (Thames mud at Barking), and the smallest in Soil XIII. (virgin soil, sand from sea-shore), the figures being respectively ·0248 and ·0034. The percentage deviation from the mean was small, considering the widely differing character of the different soils. Thus the above two extremes represent a percentage deviation from the mean of + 107 and — 71 respectively. The seven grossly polluted soils (I., II., III., IV., VII., X., XIV.) yielded on an average ·01542 (+ 28 per cent.), and the eight virgin soils (V., VI., VIII., IX., XI., XII., XIII., XV.) ·009 (— 24 per cent.) parts per 100,000 of free ammonia. Some of the virgin soils yielded nearly as much free ammonia as the average amount in the case of the polluted soils, and certain of the contaminated soils gave lower results than some of the soils which had never been fouled.

(*b*) *Albuminoid ammonia* (Col. 3, Table I).—The albuminoid ammonia was, on an average of the 15 soil waters, ·0292, which means that the average amount of organic matter was hardly three times in excess of the amount which might in ordinary circumstances be considered permissible in a potable water. The largest amount was found in Soil XV. (a virgin soil from pasture land nearly 1,000 feet above sea level) and the smallest in Soil XIII. (a virgin soil, sand from sea-shore), the figures being respectively ·1 (percentage deviation from mean + 242) and ·002 (percentage deviation from mean — 93). The seven grossly polluted soils (I., II., III., IV., VII., X., XIV.) yielded, on an average, ·0246 (differing by — 15 per cent.), and the eight virgin soils (V., VI., VIII., IX., XI., XII., XIII., XV.) ·0332 (difference of + 13 per cent. from the average of all fifteen soils), parts per 100,000 of albuminoid ammonia. It will be seen that, on an average, the soils rich in vegetable matter and free from animal pollution yielded higher results as regards albuminoid ammonia than those poor in vegetable organic matter but grossly fouled with matters of excremental origin.

(*c*) *Sum of the ammonias, free and albuminoid* (Col. 4, Table I.). The average amount in the soil waters was ·04119, the highest figure recorded being ·1134 (Soil XV., a virgin pasture soil), and the lowest ·0054 (Soil XIII., a virgin soil, sand from the sea-shore). The percentage deviation above and below the mean in these two cases bieng + 175 and — 86. The seven grossly polluted soils (I., II., III., IV., VII., X., XIV.) yielded on an average ·01002 (— over 2 per cent.), and the eight virgin soils

(V., VI., VIII., IX., XI., XII., XIII., XV.) ·04222 (+ over 2 per cent), parts per 100,000 of ammonia (free and albuminoid).

(*d.*) *Oxygen absorbed from permanganate* (4 hours at the room temperature), (Col. 5, Table I.). The average amount in the fifteen soil waters was ·3274 part per 100,000, or only about twice as much as may be found in a potable water of "medium" organic purity. The largest amount was found in Soil VI. (virgin soil, peat from moorland), and the smallest amount in Soil IX. (virgin soil, from pasture), namely, 1·484 and ·05 respectively; the percentage deviation from the mean being as regards Soil VI. + 353, and as regards Soil IX. – 84. The seven grossly polluted soils (I., II., III., IV., VII., X., XIV.) yielded, on an average, ·1512 (– 53 per cent.), and the eight virgin soils (V., VI., VIII., IX., XI., XII., XIII., XV.) ·4798 (+ 46 per cent.).

The chemical results are shown diagrammatically in diagram 1 (at end of this report).

E.—*Result of the bacteriological examination of fifteen soils as regards the number and character of the bacteria in the "washings" ("soil waters") from each sample.*

(a.) *Results as regards the total number of bacteria.*

The following is a record of the results as regards *total number of bacteria*:—

Soil I.—40 colonies in 0·1 cc. of a 10 cc. "filter brushing" of 1,000 cc. *dilute soil water*; two colonies of B. mycoides, one cladothrix. In a plate culture containing 1·0 cc. of the "filter brushing" a great many colonies of B. mycoides were noted; B. fluorescens liquefaciens was also present, but no colonies of the non-liquefying fluorescent bacteria were noticed.

Soil. II.—1,488 colonies in 1 cc. of the *dilute soil water*. No colonies of B. mycoides or the granular bacillus were noted in any of the cultures, but both liquefying and non-liquefying fluorescent bacteria were present. One colony of cladothrix was found in a plate culture containing 0·1 cc. of a 10 cc. "filter brushing" of 1,000 cc. *dilute soil water*.

Soil III.—78 colonies in 1 cc. of the *dilute soil water*; two of B. mycoides. At least six colonies of cladothrix and 10 of B. mycoides in 1·0 cc. of a 10 cc. "filter brushing" of 500 cc. *dilute soil water*.

SOIL IV.—372 colonies in 1 cc. of the *dilute soil water;* one cladothrix, but no colonies of B. mycoides noted. But in a plate culture containing 1·0 cc. of a 10 cc. "filter brushing" of 1,000 cc. *dilute soil water* 21 colonies of B. mycoides were counted.

SOIL V.—780 colonies in 1 cc. *medium soil water;* 60 of B. mycoides, and 10 of cladothrix.

SOIL VI.—90 colonies in 1 cc. *medium soil water;* two of B. mycoides.

SOIL VII.—86 colonies in 1 cc. *dilute soil water;* one colony of B. mycoides in 1·0 of 10 cc. "filter brushing" of 1,000 cc. *dilute soil water.*

SOIL VIII.—88 colonies in 1 cc. *medium soil water.* No colonies of B. mycoides or cladothrix noted, but a number of moulds of the type usually met with in peat soil cultures.

SOIL IX.—170 colonies in 1 cc. *medium soil water;* 10 of B. mycoides.

SOIL X.—32 colonies in 1 cc. of *dilute soil water;* in 1 cc. of a 10 cc. "filter brushing" of 1.000 cc. *dilute soil water*, one cladothrix, six B. fluorescens liquefaciens; but no B. mycoides noted.

SOIL XI.—1,630 colonies in 1 cc. of *medium soil water;* 20 colonies of B. mycoides, and 20 of cladothrix.

SOIL XII.—370 colonies in 1 cc. of *medium soil water;* no B. mycoides or cladothrix noted, but a number of moulds of the type usually met with in peat soil cultures.

SOIL XIII.—132 colonies in 1 cc. of *medium soil water;* one B. mycoides, one cladothrix, several colonies of B. fluorescens liquefaciens.

SOIL XIV.—280 colonies in 1 cc. *dilute soil water;* one B. mycoides, one cladothrix noted.

SOIL XV.—6,000 colonies in 1 cc. of *medium soil water;* 30 B. mycoides, 30 cladothrix, 10 B. fluorescens liquefaciens.

It will be remembered that Soils I., II., III., IV., VII., X., and XIV. were grossly polluted, and that Soils V., VI., VIII., IX., XI., XII., XIII., and XV. were virgin soils.

These results may conveniently be given in the form of a table (Table II.)

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TABLE II.

Showing the results of Bacteriological Examination of Fifteen Soils, obtained from various sources, as regards the total number of Bacteria in the "washings" (termed "soil waters") from each sample. [In the case of the virgin soils the "*medium soil water*" was used, whereas in the case of the polluted soils the "*dilute soil water*" was employed. The latter "soil water" was one hundred times weaker than the former.]

Experiment.	Description of the sample of soil. (1)	Total number of aerobic bacteria (inclusive of spores) in 1 cc. of	
		Medium soil water. (2)	*Dilute soil water.* (3)
1	Soil I. Sewage field	*See* col. 3	40 colonies in 0·1 cc. of a 10 cc. filter brushing of 1,000 cc.
2	„ II. Sewage field	*See* col. 3	1,488
3	„ III. Sewage field	*See* col. 3	78
4	„ IV. Sewage field	*See* col. 3	372
5	„ V. Virgin soil (sandy soil from pasture).	780	*See* col. 2
6	„ VI. Virgin soil (peaty soil from moorland).	90	*See* col. 2
7	„ VII. Thames mud (near Barking, at low tide).	*See* col. 3	86
8	„ VIII. Virgin soil (from a wood) ...	88	*See* col. 2
9	„ IX. Virgin soil (from a pasture) ...	170	*See* col. 2
10	„ X. Brent mud (about 100 yards below Hendon Sewage Works).	*See* col. 3	32
11	„ XI. Virgin soil (from a wood) ...	1,630	*See* col. 2
12	„ XII. Virgin soil (peaty soil from moorland).	370	*See* col. 2
13	„ XIII. Virgin soil (sand from sea-shore)	132	*See* col. 2
14	„ XIV. Sewage field	*See* col. 3	280
15	„ XV. Virgin soil (high pasture land)	6,000	*See* col. 2

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Taking first the eight virgin soils where the *medium soil water* was used, it is to be noted that the largest number of bacteria was found in the Soil XV. (pasture-land), and the smallest number in Soil VIII. (soil from a wood), namely, 6,000 and 88 respectively in 1 cc. The average number per cc. of medium soil water was 1,157.

As regards the seven polluted soils, omitting Soil I., as here the cultures were made from the 10 cc. filter brushing of 1,000 cc. *dilute soil water*, it is to be noted that the largest number of microbes was found in Soil II. (sewage field), and the smallest number in Soil X. (Brent mud), namely, 1,488 and 32 respectively in 1 cc. of the *dilute soil water*. The average number (omitting Soil I.) per cc. of dilute soil water was 389. On the whole, having regard to the dilutions employed, there was evidence that the total number of bacteria was conspicuously, though not uniformly, in excess in the case of the polluted soils. That the distinction was not even greater is possibly to be attributed to the large number of bacteria capable of forming spores which at one time or another find their way into soils of all kinds. These microbes by forming spores serve to maintain the number of bacteria in soils in general at a high figure.

As to the *sorts of bacteria* found in the cultivations, the results obtained confirmed those recorded in my previous reports. Thus the B. mycoides and cladothrix were commonly present. The *granular bacillus* was also a common inhabitant of the soil washings, its presence being best detected in surface plate cultures. In Soil XI. there were present 20 B. mycoides and 20 cladothrix in 1 cc. of the *medium soil water*. In Soil XV. the number of B. mycoides was 30 and of cladothrix 30 per cc. of the *medium soil water*. Even in the *dilute soil waters* the presence of these germs was frequently noted, most readily, of course, in cultures made from the "filter brushings" of this dilution. This is important because it shows that "flood water" from soils gaining access to a water supply even in minute amount might readily be indicated by the presence of these soil bacteria.

(b.) *Result as regards the number of spores of aerobic bacteria.*

Next as to the *number of spores* of *aerobic bacteria* in the "soil waters." The following is a brief account of the results obtained in this direction :—

Soil I.—142 colonies in 1 cc. of a 10 cc. "filter brushing" of 1,000 cc. *dilute soil water*: at least 32 of B. mycoides.

Soil II.—64 colonies in 1 cc. of a 10 cc. "filter brushing" of 1,000 cc. *dilute soil water*: one colony of B mycoides.

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Soil III.—196 colonies in 1 cc. of a 10 cc. "filter brushing" of 500 cc. *dilute soil water:* one colony of B. mycoides.

Soil IV.—124 colonies in 1 cc. of a 10 cc. "filter brushing" of 1,000 cc. *dilute soil water:* two of B. mycoides.

Soil V.—684 colonies in 1 cc. of *medium soil water:* 26 of B. mycoides.

Soil VI.—20 colonies in 1 cc. of *medium soil water:* four of B. mycoides.

Soil VII.—10 colonies in 1 cc. of a 10 cc. "filter brushing" of 1,000 cc. *dilute soil water:* one of B. mycoides.

Soil VIII.—The colonies were not counted: they were numerous.

Soil IX.—51 colonies in 1 cc. of *medium soil water:* three of B. mycoides.

Soil X.—10 colonies in 1 cc. of a 10 cc. "filter brushing" of 1,000 cc. *dilute soil water:* one of B. mycoides and one of B. mesentericus.

Soil XI.—384 colonies in 1 cc. of *medium soil water:* one of B. mycoides.

Soil XII.—145 colonies in 1 cc. of *medium soil water:* no B. mycoides noted.

Soil XIII.—386 colonies in 1 cc. *strong soil water:* no B. mycoides noted.

Soil XIV.—43 colonies in 1 cc. of a 10 cc. "filter brushing" of 1,000 cc. *dilute soil water:* five of B. mycoides.

Soil XV.—2,560 in 1 cc. *medium soil water:* no B. mycoides noted.

These results, as regards the number of spores of bacteria, are shown in the following table (Table III.):—

TABLE III.

Showing the results of Bacteriological Examination of Fifteen Soils, obtained from various sources, as regards the number of spores of Aerobic Bacteria in the "washings" (termed "soil waters") from each sample. [In the case of the virgin soils the *medium soil water* was used, whereas in the case of the polluted soils a portion of the "filter brushings" of 1,000 cc. of *dilute soil water* was employed.

Experiment.	Description of the sample of soil. 1	Number of spores of aerobic bacteria in 1 cc. of	
		Medium soil water. 2	10 cc. "filter brushing" of 1,000 cc. *dilute soil water.* 3
1	Soil I. Sewage field	*See* col. 3	142
2	" II. Sewage field	*See* col. 3	64
3	" III. Sewage field	*See* col. 3	196*
4	" IV. Sewage field	*See* col. 3	124
5	" V. Virgin soil (sandy soil from pasture).	684	*See* col. 2
6	" VI. Virgin soil (peaty soil from moorland).	20	*See* col. 2
7	" VII. Thames mud (near Barking, at low tide).	*See* col. 3	10
8	" VIII. Virgin soil (from a wood) ...	Numerous, not counted.	*See* col. 2
9	" IX. Virgin soil (from a pasture) ...	51	*See* col. 2
10	" X. Brent mud (about 100 yards below Hendon sewage works).	*See* col. 3	10
11	" XI. Virgin soil (from a wood) ...	384	*See* col. 2
12	" XII. Virgin soil (peaty soil from moorland).	145	*See* col. 2
13	" XIII. Virgin soil (sand from sea-shore)	386†	*See* col. 2
14	" XIV. Sewage field	*See* col. 3	43
15	" XV. Virgin soil (high pasture land) ...	2,560	*See* col. 2

* Here 500 instead of 1,000 cc. filtered.

† Here the *strong soil water* instead of the *medium soil water* used.

In commenting on these results note must be taken of the following points:—

The number of spores both actually and relatively to the total bacterial flora was great in all the soils, and in some of them was remarkable. Thus Soil XV. contained no fewer than 2,560 spores per cc. of *medium soil water*.

In nearly all the soils the spores of B. mycoides were found, and sometimes the notes show a record of more colonies of this microbe in the spore plate than in the ordinary plate (the same quantity being used in each case), the reason being that its growth can be much more easily appreciated in the cultures for spores than in the ordinary cultivations for total number of bacteria.

The number of spores of aerobic bacteria in soils has apparently no relation to the amount of pollution, except that, of course, other things being equal, the greater the total number of microbes present the larger are the number of spores likely to be. Indeed, it sometimes happens that the more gross the pollution the less are the number of spores found in the cultures. Presumably the explanation lies in the fact that the presence of a large amount of assimilable organic matter would encourage the active growth and multiplication of those bacteria that are capable of forming spores under less favourable conditions of environment.

In previous reports it has been pointed out that the number of spores (both the actual number and the number relative to the total bacterial flora) in soils is very great, thus offering in this respect a striking contrast to sewage and potable waters, when the number of spores actually and relatively to the total number of microbes is apt to be small. And it has been suggested that an appreciation of this fact, coupled with a knowledge of the sorts of bacteria occurring in soils in spore-form, may prove of signal service in demonstrating the entrance of "flood water" into a water-supply. That "flood water" has in the past been responsible for causing epidemics of disease no one is likely to deny; that it is always dangerous to health may be open to dispute. But anything which enables us to detect its presence is of value as enabling us to say—here is a possible, although not necessarily a probable source of danger, or here is a potential danger which at any moment may become an actual one.

There is another aspect of the question, namely, that sometimes the power of recognizing the presence of "soil water" is of importance as allowing the bacteriologist to take a more lenient view than otherwise of the presence of a large total number of bacteria in a water supply. Thus if micro-organisms of the class of B. coli and streptococci were absent the presence of an undue number of germs might be regarded as *comparatively* unobjectionable if there was sufficient evidence that such bacteria were derived from soil not *recently* polluted with animal matters. In other words, recognition of the above sort might enable the bacteriologist to say there are too many bacteria in this water, but they appear to be largely derived not from sewage contamination but from soil, and soil, moreover, not *recently* polluted. It must be understood

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TABLE IV.—*continued.*

Experiment.	Description of the sample of soil.	Subculture of colonies resembling (more or less closely) B. coli in		
		Broth; for (*a*) diffuse cloudiness in 24 hrs. at 37° C., and (*b*) indol test 5th day at 37° C.	Gelatine "shake" cultures for gas formation, 20° C.	Litmus milk: for (*a*) acidity, and (*b*) clotting at 37° C.
8	Soil VIII. Virgin soil. 0·1 cc. of the *medium soil water.* [? B. coli] 12.	(*a*) Not typical of B. coli. (*b*) –	– (growth only near the surface, none in the depth).	Practically no change, even after 5 days.
9	„ IX. Virgin soil. 0·1 cc. of the *medium soil water.* [? B. coli] 13.	Practically no growth at 37° C.	– (growth only near the surface, none in the depth).	No visible change.
10	„ X. Brent mud (about 100 yds. below Hendon Sewage Works). 0·1 cc. of a 10 cc. "filter brushing" of 1,000 cc. *dilute soil water.* [? B. coli] 14.	Practically no growth at 37° C.	–	No visible change.
11	„ XI. Virgin soil. 0·1 cc. of the *medium soil water.* [? B. coli] 15.	Only very slight growth at 37° C.	– (turned out to be a variety of B. fluorescens non-liquefaciens).	No visible change.
12	„ XII. Virgin soil. 0·1 cc. of the *medium soil water.* No colonies even remotely like B. coli, so no subcultures were made.	..	..	..
13	„ XIII. Virgin soil. 0·1 cc. of the *strong soil water.* No colonies even remotely like B. coli, so no subcultures were made.	..	..	..
14	„ XIV. Sewage field. 0·1 cc. of a 10 cc. "filter brushing" of 1,000 cc. *dilute soil water.* [? B. coli] 16.	(*a*) + (*b*) +	+ in 24 hours.	(*a*) + in 24 hrs. (*b*) + solid clot by 3rd day.
15	„ XV. Virgin soil. 0·1 cc. of the *medium soil water.* No colonies even remotely like B. coli, so no subcultures were made.	..	..	..

In considering the results it will be noted that in dealing with the eight virgin soils (V., VI., VIII., IX., XI., XII., XIII., and XV.) the *medium soil water* was used, except in the case of Soil XIII., when the *strong soil water* was employed. Yet in no case was B. coli, or microbes having close kinship to B. coli, found. In some cases no colonies even remotely resembling B. coli could be seen in the cultures. In other cases microbes were subcultured, either because they bore some superficial resemblance to B. coli, or because among all the other germs present in the cultures they were *least unlike* B. coli. Yet in no single instance was a positive result obtained.

As regards the seven polluted soils (I., II., III., IV., VII., X., and XIV.), the *dilute soil water* (one hundred times weaker than the *medium soil water*) was used. In the case of Soils III. (sewage field), VII. (Thames mud), and X. (Brent mud), the result was negative; but it is quite possible, perhaps even probable, that a positive result might have been obtained if the *medium* instead of the *dilute soil water* had been employed, using the filter brushing method. In all the other soils B. coli (or closely allied forms) was demonstrated; namely, in Soils I., II., IV., and XIV. (all from sewage fields).

The above results confirm in a striking manner those obtained in 1897–8 and 1898–9 (App. B, No. 2, and App. B, No. 5). They seem to show conclusively that B. coli (or its close allies) is not discoverable or is present in small number only in *pure* soils. Further, they would seem to indicate that B. coli is not readily isolated even from soils polluted with objectionable animal matters unless, indeed, the contamination is gross in amount and of *recent* sort. Now, it has been shown that the entrance of "flood water" from the "surface washings" of soils into a water-supply might be detected by the presence of soil bacteria (*e.g.*, B. mycoides and cladothrix and the granular bacillus) and by an increase in the number of spores both actually and relatively to the total bacterial flora. Whether the presence of such "flood water" should be regarded as actually or potentially dangerous or not, might, as it appears from the above results, be in large measure decided by the presence or absence of B. coli (and its close allies).

Chemically considered, it is customary to speak of the total inorganic nitrogen (free ammonia, nitrites and nitrates) as relating to the *past* and the organic nitrogen to the *present* condition of a water, and to consider the former as indicative of potential, and the latter of actual, danger to health. This distinction is of value for practical purposes, although, of course, it must be remembered that organic nitrogen is not, *per se*, harmful; it is the bacteria of putrefaction and disease likely to be associated with it that constitute the element of danger. Are there in the bacteriological sense any parallel processes to distinguish past and present pollution? Indubitably there are: tests which in point of delicacy greatly excel any chemical methods at present known The presence of B. coli in soil or in "washings" from soil must be allowed to form important evidence of *recent*, and therefore presumably specially dangerous, animal pollution. Presently it will be urged that the presence of streptococci affords presumptive evidence of even stronger kind that the contamination is of *recent* animal outcome. And, as regards the *past history* of soil in respect of objectionable pollution, evidence of the most valuable kind is furnished by the number of spores of B. enteritidis sporogenes. Determination of the number of these spores enables the bacteriologist to say whether the soil has at one time or another been contaminated, and, in a measure, to *gauge the extent of past fouling* by the *number of such spores*. And according to whether microbes of the class of B. coli and streptococci are likewise present or are absent it can be ascertained whether the pollution shown by the presence of B. enteritidis is recent or is probably remote in character. The absence of the spores of B. enteritidis sporogenes from soil or water may, on the other hand, be relied upon to show the absence of pollution of objectionable sort recent or remote. It is here assumed, and all the available evidence supports such a view, that the spores of B. enteritidis sporogenes are always associated with other objectionable microbes of intestinal origin, *e.g.*, B. coli and streptococci, although, even in the case of quite recent contamination by animal organic matter, the relative proportion of these several intestinal micro-organisms may, and indeed does, vary within certain limits.

These remarks may be summed up briefly as follows :—

The absence of the spores of B. enteritidis sporogenes from a substance, be it soil or water, would seem to imply the absence of pollution of animal origin, *recent* or *remote*, and almost certainly implies the absence of all non-sporing germs of pathogenic sort.

The presence of the spores of this microbe suggests very strongly objectionable contamination, but does not indicate whether the polluting material has recently, or at a remote period, been extruded by animals.

The absence of microbes of the class of B. coli and streptococci goes far to show that the pollution is not *recent* in character, and so is probably *comparatively* unobjectionable.

The presence of B. coli and streptococci affords presumptive evidence of the strongest kind that the contamination is *recent* and therefore *specially liable to be dangerous*.

(d.) *Results as regards the presence of spores of B. enteritidis sporogenes (Klein).*

The following is an account of the results obtained as regards the presence of spores of B. enteritidis sporogenes in the various "soil waters" :—

Soil I.—A positive result was obtained with 2 cc., but not with 0·1 cc. or with 1 cc., of a 10 cc. "filter brushing" of 1,000 cc. *dilute soil water*.

Soil II.—A positive result was obtained with 2 cc. and 1 cc., but not with 0·1 cc., of a 10 cc. "filter brushing" of 1,000 cc. *dilute soil water*.

Soil III.—A positive result was obtained with 3 cc. and 1 cc., but not with 0·1 cc., of a 10 cc. "filter brushing" of 500 cc. *dilute soil water*.

Soil IV.—A positive result was obtained with 2 cc., and 1 cc., but not with 0·1 cc., of a 10 cc. "filter brushing" of 1,000 cc. *dilute soil water*.

Soil V. }
Soil VI. } A negative result with 0·1 cc., 1·0 cc., and 10 cc. of the *medium soil water*.

Soil VII.—A positive result was obtained with 2 cc. and 1 cc., but not with 0·1 cc, of a 10 cc., "filter brushing" of 1,000 cc. *dilute soil water*.

Soil VIII. }
Soil IX. } A negative result with 0·1 cc., 1·0 cc., and 10 cc. of the *medium soil water*.

Soil X.—A negative result with 2 cc., 1 cc., and 0·1 cc. of a 10 cc. "filter brushing" of 1,000 cc. *dilute soil water*. But a positive result was obtained with 10 cc., 1 cc., and 0·1 cc. of the *medium soil water*.

Soil XI. }
Soil XII. } A negative result with 0·1 cc., 1 cc., and 10 cc. of the *medium soil water*.

Soil XIII.—A negative result with 1 cc. and 10 cc. of the *strong soil water*.

Soil XIV.—A positive result with 2 cc. and 1 cc., but not with 0·1 cc., of a 10 cc. "filter brushing" of 1,000 cc. *dilute soil water*.

Soil XV.—A negative result with 0·1 cc., 1 cc., and 10 cc. of the *medium soil water*.

These results may conveniently be arranged in tabular form (Table V.) as follows :—

TABLE V.

APP. B, NO. 4.

On the Chemical and Bacteriological Examination of "Washings" of Soils; by Dr. Houston.

Showing the Results of Bacteriological Examination of Fifteen Soils, obtained from various sources, as regards the presence of Spores of B. Enteritidis Sporogenes (Klein) in the "washings" (termed "soil waters"), from each sample. [In the case of virgin soils the *medium soil water* was used, except in Soil XIII., where the *strong soil water* was tried; whereas in the case of the polluted soils a portion of the "filter brushings" of 1,000 cc. of *dilute soil water* were employed.

The sign + signifies positive result, *i.e.*, typical changes in the milk.
The sign — signifies negative result, *i.e.*, no changes (or not characteristic changes) in the milk.

Experiment.	Description of the Sample of Soil.	*Medium soil water.* The amount used was			*Dilute soil water.* The amount used of a 10 cc. "filter brushing" of 1,000 cc. was		
		10 cc.	1 cc.	0·1 cc.	2 cc.	1 cc.	0·1 cc.
1	Soil I. Sewage field ...	...	...	...	+	—	—
2	„ II. „ „ ...	...	...	...	+	+	—
3	„ III. „ „ ...	...	...	...	[+3 cc.	+	—]*
4	„ IV. „ „ ...	...	...	...	+	+	—
5	„ V. Virgin soil ...	—	—	—	...	...	...
6	„ VI. „ „ ...	—	—	—	...	...	...
7	„ VII. Thames mud ...	...	...	...	+†	+‡	—
8	„ VIII. Virgin soil ...	—	—	—	...	...	...
9	„ IX. „ „ ...	—	—	—	...	...	...
10	„ X. Brent mud ...	+	+	+	—	—	—
11	„ XI. Virgin soil ...	—	—	—	...	...	...
12	„ XII. „ „ ...	—	—	—	...	...	...
13	„ XIII. „ „ ...	[—	—	]§	...	...	...
14	„ XIV. Sewage field ...	...	...	...	+‖	+¶	—
15	„ XV. Virgin soil ...	—	—	—	...	...	...

* In this experiment 500 cc. instead of 1,000 cc. *dilute soil water* were filtered.
† 0·5 cc. of this culture killed a guinea-pig in 24 hours.
‡ 0·5 cc of this culture proved to be non-virulent.
§ In this experiment the *strong* instead of the *medium soil water* was employed.
‖ 1 cc. of this culture killed a guinea-pig in 24 hours.
¶ 1 cc. of this culture killed a guinea-pig in 3 days.

These results must be regarded as striking. Of the eight virgin soils (V., VI., VIII., IX., XI., XII., XIII., and XV.) not one yielded a positive result even when 10 cc. of the *medium soil water* were used, and soil XIII. gave a negative result with 10 cc. of the *strong soil water*. These negative results contrast with those obtained with the polluted soils (I., II., III. IV., VII., X., and XIV.) when working with *dilute soil water* aided by the filter brushing method. In only one case—namely, soil X. (Brent mud)—was a negative result obtained with 2 cc. of a 10 cc. "filter brushing" of 1,000 cc. *dilute soil water*, and here a positive result was got by falling back on the *medium soil water*, without recourse to filtration and brushing, and by using so minute a quantity as 0·1 cc. of it. All the other soils gave a positive result with 1 cc. (except soil I., which required 2 cc.) of a 10 cc. "filter brushing" of 1,000 cc. (in soil III. 500 cc. only were used) *dilute soil water*.

These results confirm in a most effective manner the results of the work of previous years. It may not be amiss in this connexion to quote from last year's Report (p. 459, App. B, No. 5, 1898–9) as follows:—"It is evident from the above results that the spores of B. enteritidis are present in the "washings" of *impure* soils and absent (or present in fewer numbers) in the "washings" of *pure* soils. It cannot, therefore, well be said that the surface drainage from *pure* soils equally with *polluted* soils would contaminate a water supply with the spores of this pathogenic anaërobe. Last year's Report (App. B, No. 2) was equally definite in this respect since, generally speaking, it was found that *impure* soils contained B. enteritidis in great numbers and *pure* soils in very small amount. Thus some polluted soils contained 10,000 spores per gramme of soil and some virgin soils none in 10 milligrams of soil."

Some time has now elapsed since Dr. Klein's discovery of the B. enteritidis sporogenes. But bacteriologists have been so busy with criticisms that they seem to have missed, among other things, the significance of this discovery in relation to the bacterioscopic examination of potable waters. In App. B, No. 1, 1897–8, Dr. Klein shows a micro-photograph (Plate III., Fig. 6) of the highly characteristic appearance produced in anaërobic milk cultures by the growth of this microbe. Now, as some would have it, suppose that this change in milk can be produced by other germs besides B. enteritidis sporogenes, that the pathogenic properties of such a culture may be ignored, and that the causal relation of Klein's micro-organism to certain cases of acute diarrhœa in the human subject may be doubted or denied. Assume even that the changes in milk may be regarded simply as a phenomenon resulting on the introduction of certain chemical substances as opposed to others, and disregard their microbial origin altogether. All this, however, amounts to nothing when considering the value of the test, as a test, in the examination of potable waters, as the following facts show.

The particulate matter of as much as 500 cc. or more of a *pure* water is incapable of producing the characteristic phenomenon of the test when added to sterile milk.

Yet so minute a quantity as one-hundredth to one-thousandth cc. of raw sewage is almost invariably sufficient to produce this change.

As regards soil, 10 milligrams (or it may be much more) of virgin soil yields a negative result; whereas a tenth part of a milligram of a polluted soil is frequently enough to create a transformation in the milk similar to that shown in Dr. Klein's illustration. Similarly, the "washings" of pure soil, even in considerable amount, yield a negative result, while the "washings" of soil polluted with excremental matters give a positive result in minimal quantities.

Finally, we do not know of any organic material of excremental origin likely at any time to pollute a water supply which does not possess the power of producing the characteristic phenomenon of this test in greater or less amount.

(e.) *Results as regards the Presence of Streptococci.*

The following is an account of the results, as regards the presence of streptococci, of the examination of the various "soil waters":—

SOIL I.—No streptococci could be found in an agar plate culture (37° C.) containing 0·1 cc. of a 10 cc. "filter brushing" of 1,000 cc. *dilute soil water.*

SOIL II.—In an agar plate culture (37° C.) containing 0·1 cc. of a 10 cc. "filter brushing" of 1,000 cc. *dilute soil water* a microbe was isolated which at first was thought to be a streptococcus, but later it was regarded as a bacillus simulating a streptococcus. In a gelatine plate culture (20° C.), however, containing a similar quantity of "soil water," a streptococcus was found.

SOIL III.—No streptococci could be found in an agar plate culture (37° C.) containing 0·1 cc. of a 10 cc. "filter brushing" of 500 cc. *dilute soil water.*

SOIL IV.—Streptococci were found both in agar (37° C.) and gelatine (20° C.) plate culture, each containing 0·1 c. of 10 cc. "filter brushing" of 1,000 cc. *dilute soil water.*

SOIL V. }
SOIL VI. } No streptococci were found in agar plate cultures (37° C.) containing 0·1 cc. *medium soil water.*

SOIL VII.—Streptococci were found both in agar (37° C.) and gelatine (20° C.) plate culture, each containing 0·1 cc. of a 10 cc. "filter brushing" of 1,000 cc. *dilute soil water.*

SOIL VIII. }
SOIL IX. } No streptococci were found in agar plate cultures containing 0·1 cc. *medium soil water.*

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On the Chemical and Bacteriological Examination of "Washings" of Soils; by Dr. Houston.

Soil X.—No streptococci could be found in an agar plate culture (37° C.) containing 0·1 cc. of a 10 cc. "filter brushing" of 1,000 cc. *dilute soil water*. A negative result was also obtained with 0·1 cc. of the *medium soil water*.

Soil XI. }
Soil XII. } No streptococci were found in agar plate cultures (37° C.) containing 0·1 cc. *medium soil water*.

Soil XIII.—No streptococci were found in an agar plate culture (37° C.) containing 0·1 cc. of the *strong soil water*.

Soil XIV.—Streptococci were found in an agar plate culture (37° C.) containing 0·1 cc. of a 10 cc. "filter brushing" of 1,000 cc. *dilute soil water*.

Soil XV.—No streptococci could be found in an agar plate culture (37° C.) containing 0·1 cc. of the *medium soil water*.

These results are arranged in tabular form in Table VI.:—

Table VI.

Showing the results of Bacteriological Examination of Fifteen Soils, obtained from various sources, as regards the presence of Streptococci in the "washings" (termed "soil waters") from each sample. [In the case of the virgin soils the *medium soil water* was used; *see*, however, note ‡: and in the case of the polluted soils the filter brushings of *dilute soil water* was employed; *see*, however, note.†]

Experiments.	Description of the sample of soil. (1)	*Medium soil water.* The amount used was 0·1 cc. (2)	*Dilute soil water.* The amount used was 0·1 cc. of a 10 cc. "filter brushing" of 1,000 cc. (3)
1	Soil I. Sewage field	*See* col. 3	Negative result.
2	" II. " "	" "	Positive result.
3	" III. " "	" "	Negative result.*
4	" IV. " "	" "	Positive result.
5	" V. Virgin soil	Negative result	*See* col. 2.
6	" VI. " "	" "	" "
7	" VII. Thames mud	*See* col. 3	Positive result.
8	" VIII. Virgin soil	Negative result	*See* col. 2.
9	" IX. " "	" "	" "
10	" X. Brent mud	" "†	Negative result.*
11	" XI. Virgin soil	" "	*See* col. 2.
12	" XII. " "	" "	" "
13	" XIII. " "	" "‡	" "
14	" XIV. Sewage field	*See* col. 3	Positive result.
15	" XV. Virgin soil	Negative result	*See* col. 2.

* 500 cc. instead of 1,000 cc. filtered.
† Here the *medium* as well as the *dilute soil water* was used.
‡ Here the *strong* instead of the *dilute soil water* was used.

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On the Chemical and Bacteriological Examination of Soils; by Dr. Houston.

It is to be noted that in the case of the eight virgin soils 0·1 cc. of the *medium soil water* (except in Soil XIII., when 0·1 cc. *strong soil water* was employed) was used. Yet no streptococci were found in any of the cultures. As regards the polluted soils 0·1 cc. of a 10 cc. "filter brushing" of 1,000 cc. *dilute soil water* (one hundred times weaker than the medium soil water) was invariably used, but in the case of Soil X. 0·1 cc. of the *medium soil water* was also tried. In four of the polluted soils (II., IV., VII., and XIV.) a positive result was obtained, but in the remaining three (Soils I., III., and X.) the result was negative. The failure as regards Soils I. (sewage field), III. (sewage field), and X. (Brent mud) is possibly to be attributed to the death of the streptococci, for that they were present in these soils at one time need hardly be doubted. Such a view would be in accordance with the rationale of the test presently to be dealt with. However this may be, it is of great interest to note that a totally negative result was obtained in the case of all the virgin soils and when using the *medium soil water*, and a positive result in four out of the seven polluted soils and when working by the filter brushing method with a soil water *one hundred times more dilute.*

In last year's Report (App B, No. 5, and App. B, No. 6) the significance of streptococci in soil and in water was dealt with at some length. It was pointed out that streptococci, *as a class*, are delicate germs, that readily lose their vitality and die when the physical conditions are unfavourable, and that they comprise species highly pathogenic to human beings. Further, it was stated that streptococci are present in human fæces and in crude sewage in considerable number; and that they appear to be absent from pure water and virgin soils, but present in abundance in water and soil *recently* polluted with animal dejecta. It was not indeed claimed that *all* streptococci are necessarily delicate germs or pathogenic or of recent animal outcome. For it might well be the case that certain streptococci are comparatively hardy germs, and that others may be capable of multiplying in nature outside the animal body. Again there may be streptococci in nature which do not owe their origin to excremental matter, and doubtless many of them may be non-pathogenic, although this latter circumstance is no proof that at a stage prior to their isolation they were non-virulent. In advocating this streptococcus test as a means of judging the past history of a soil or water in respect of animal pollution, therefore, no extravagant claims were made, and no conclusions were drawn other than provisionally or tentatively. Yet the results obtained since then, both in the present investigation and in the examination of polluted waters (App. B, No. 3), have been of so encouraging a nature that claim might almost be made that this test is the most delicate yet suggested for detecting *recent* and therefore, presumably, *specially dangerous* pollution.

The following is an account of the chief morphological and biological characters of the streptococci, or microbes closely simulating streptococci, met with in the various "soil waters":—

[? STREPTOCOCCUS I.]

Source.—Agar plate cultures (37° C.) containing 0·1 cc. of a 10 cc. "filter brushing" of 1,000 cc. *dilute soil water.* Soil II. (sewage field).

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Morphology.—Stains well by Gram's method. In some fields distinct and fairly long chains of cocci, but in other fields the whole or a portion of chains made up of bacillary and often swollen-looking elements Generally speaking, the cells seemed too large for a streptococcus.*

Plate cultures (under a low power of the microscope.)

(*a.*) *Gelatine* (20° C.).—Colonies nearly circular in shape and faintly granular. The edge is smooth, the colonies are somewhat larger and less transparent than is usually the case with streptococci. No liquefaction.

(*b.*) *Agar* (37° C.)—Small, faintly granular, nearly circular colonies, with fairly smooth edge, and more transparent than in the case of gelatine cultures.

Gelatine streak cultures (20° C.).—The colonies are small and streptococcus-like in character. No liquefaction.

Broth cultures (37° C.) —Diffuse, but not very abundant, cloudiness in 24 hours.

Litmus milk cultures (37° C.).—No visible change in 48 hours. Later, trace of acid.

Remarks.—This microbe was finally classed as a bacillus simulating a streptococcus.

STREPTOCOCCUS II.

Source.—Gelatine plate culture (20° C.) containing 0·1 cc. of a 10 cc. "filter brushing" of 1,000 cc. *dilute soil water.* Soil II. (sewage field).

Morphology.—Stains well by Gram's method. Immensely long chains of cocci resembling S. longus.†

Plate cultures (under a low power of the microscope).

(*a.*) *Gelatine* (20° C.).—The colonies are minute and transparent and markedly irregular in shape, showing convoluted loops of cocci at the periphery. The loops commonly run in parallel rows so as to produce ribbon-like convolutions, but separate loops of cocci may readily be noted. No liquefaction.

(*b.*) *Agar* (20° C.).—The colonies are minute and transparent and present an exquisite appearance resembling a loose tangle of loops without beginning or end. Here the separate loops are much more prominent, and the parallel rows (ribbon-like bands) of cocci much less distinct.‡

Gelatine streak culture (20° C.).—The colonies are small, separate, and transparent, and somewhat irregular in shape. Viewed with a hand lens they appear faintly granular. No liquefaction.

Broth cultures(20° C.).—The liquid remains perfectly clear and transparent. At the foot of the tube the growth appears as a white fleecy cloud.§

Litmus milk cultures (20° C.).—No visible change even after ten days, except that at the foot of the tube there is a whitish appearance.

Remarks.—Comparative cultivations were made at 20° C. and at 37° C.: undoubtedy 20° C. is the most favourable temperature, although growth also takes place at blood-heat. Streptococci which do not grow luxuriantly at 37° C. can hardly be considered as significant as those which prefer this temperature. But, so far as my experience goes, streptococci which grow best at 20° C. are apt to be abundantly present in recently polluted soils, and absent (or seemingly so) from virgin soils. As a test then of recent pollution these streptococci (growing best at 20° C.) are possibly, perhaps probably as important as those whose optimum temperature is 37° C. but since they cannot reasonably be considered as microbes likely to have been recently extruded from the intestinal tract of animals their significance is narrowed.

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* Fig. 2, Plate XXXII. † Fig. 3, Plate XXXII. ‡ Fig. 4, Plate XXXII.
§ Fig. 5 (middle tube) Plate XXXIII.

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STREPTOCOCCUS III.

Source.—Agar plate culture (37° C.) containing 0·1 cc. of a 10 cc. "filter brushing" of 1,000 cc. *dilute soil water.* Soil IV. (sewage field).

Morphology.—Stains well by Gram's method. Chains of cocci of variable length, showing some tendency to cohere in masses.*

Plate cultures (under a low power of the microscope).

(*a.*) *Gelatine* (20° C.).—Small transparent circular colonies with *clean* edge, and faintly granular. No liquefaction.

(*b.*) *Agar* (37° C.).—Minute transparent nearly circular colonies with *clean* edge, and showing faint wavy granulation.

Gelatine streak cultures (20° C.).—Small transparent slowly growing colonies. No liquefaction.

Broth cultures (37° C.).—Absolutely clear liquid, with at foot and sides tenacious, veil-like, white growth.

Litmus milk cultures (37° C.).—In 24 hours, acidity. By third day distinct acidity, but no clot. Eighth day still no clot.

STREPTOCOCCUS IV.

Source.—Gelatine plate culture (20° C.) containing 0·1 cc. of a 10 cc. "filter brushing" of 1,000 cc. *dilute soil water.* Soil IV. (sewage field).

Morphology.—Stains well by Gram's method. Immensely long chains of cocci; resembles S. Longus.

Plate cultures (under a low power of the microscope).

(*a*) *Gelatine* (20° C.).—Small transparent colonies made up of an entanglement of loops apparently without beginning or end. No liquefaction.†

(*b*) *Agar* (20° C.).—The same beautiful appearance is observed in agar culture.

Gelatine streak cultures (20° C.).—The colonies are transparent, irregular in shape, and granular looking. The growth is less slow and the colonies less minute than usually is the case with streptococci whose optimum temperature is 37° C.

Broth cultures (20° C.).—The broth remains perfectly transparent and at the foot of the tube there is an abundant white growth, fleecy and cumulus-like in appearance.

Litmus milk cultures (20° C.).—No visible change in 24 hours. By second day distinct acidity but no clot; tenth day same remarks.

Remarks.—Although this streptococcus grows best at 20° C. it can also develop at 37° C., but the growth is not so luxuriant. See remarks, in this connection, under Streptococcus II.

STREPTOCOCCUS V.

Source.—Same as Streptococcus IV.

Morphology.—Stains well by Gram's method. Resembles Streptococcus IV. very closely.

Plate cultures.—The appearances both in gelatine ‡ and agar culture are very similar to Streptococcus IV.

Gelatine streak cultures (20° C.).—Resembles Streptococcus IV. very closely.

Broth cultures (20° C.).—The medium remains perfectly transparent, at the foot of the tube a white woolly (cumulus-like) growth. Resembles Streptococcus IV.

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* Fig. 6, Plate XXXIII. † Fig. 7, Plate XXXIII. ‡ Fig. 8, Plate XXXIV.

Litmus milk cultures (20° C.).—Same remarks as under Streptococcus IV. except that there is less of acidity.

Remarks.—This microbe, like Streptococcus IV., grows better at 20° C. than 37° C. It is probably identical with Streptococcus IV., or, at all events, closely allied to it.

STREPTOCOCCUS VI.

Source.—Same as Streptococcus IV. and V.

Morphology.[*]—Stains well by Gram's method.

Plate cultures
Gelatine streak cultures
Broth cultures
Litmus milk cultures
} Resemble Streptococcus IV. very closely.

Remarks.—Probably identical with Streptococcus IV.

STREPTOCOCCUS VII.

Source.—Same as Streptococci IV., V., and VI.

Morphology.—Stains well by Gram's method. Immensely long chains of cocci, which tend to run in parallel rows so as to form bands. The appearance is remarkable in that the chains look as if they had been longitudinally compressed, so as to cause the cocci to become flattened against each other. The opposite appearance is much more frequent among streptococci, namely, a look as if the chains had been stretched longitudinally so as to make the cocci oval in shape, their long diameter running in the line of the chain, not at right angles to it, as in Streptococcus VII.

Plate cultures.—Very similar to Streptococcus IV., but the colonies in gelatine cultures are larger.[†]

Gelatine streak cultures.—Very similar to Streptococcus IV., but the colonies attain a much larger size, although preserving their transparent appearance.

Broth cultures (20° C.).—The medium remains quite transparent. The growth at the foot of the tube is not nearly so luxuriant as in the case of Streptococci IV., V., and VI., and consists of a few fluffy white masses.

Litmus milk cultures (20° C.)—Slight acidity, but no clot.

Remarks.—Grows only feebly at 37° C.; the optimum temperature being 20° C. See remarks, in this connection, under Streptococcus II. It is, of course, open to anyone to say this microbe is not in reality a streptococcus at all, but a bacillus simulating a streptococcus. Even if this be true, its significance in relation to objectionable pollution is not destroyed, since it appears to be one of a class of microbes apt to be present in abundance in recently polluted soils, and absent (or comparatively so) from virgin soils and soils not *recently* fouled with excremental matter. It is a point not to be lost sight of that these admittedly peculiar types of streptococci are not only absent or present in much fewer number in virgin soils, and present usually in abundance in soils recently contaminated with animal matters, but also that they are commonly associated in the latter case with microbes as clearly streptococci as are S. Brevis, S. Pyogenes and S. Longus.

STREPTOCOCCUS VIII.

Source.—Agar plate culture (37° C.) containing 0·1 cc. of a 10 cc. "filter brushing" of 1,000 cc. *dilute soil water.* Soil VII. (Thames mud).

Morphology.—Stains well by Gram's method. The cocci are very small and arranged in pairs and short chains, and in clusters simulating a staphylococcus.

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[*] Fig. 9, Plate XXXIV.

[†] Fig. 10, Plate XXXIV.

Plate cultures (under a low power of the microscope).

(*a*) Gelatine (20° C.), small transparent, circular, finely granular colonies, with *clean* edge. No liquefaction.

(*b*) Agar (37° C.), small transparent finely granular colonies, more or less circular in shape, with *clean* or only slightly frayed edge.

Gelatine streak cultures (20° C.).—The growth is very suggestive of a streptococcus, the colonies being separate, minute, and transparent looking. No liquefaction.

Broth cultures (37° C.).—Diffuse cloudiness.

Litmus milk cultures (37° C.). Slight acidity but no clot (8 day).

Remarks.—This microbe was finally classed as a streptococcus simulating (morphologically) a staphylococcus.

STREPTOCOCCUS IX.

Source.—Gelatine plate culture (20° C.) containing 0·1 cc. of a 10 cc. "filter brushing" of 1,000 cc. *dilute soil water.* Soil VII. (Thames mud).

Morphology.—Stains well by Gram's method. Very long chains of cocci running often in parallel rows to form bands (ribbon-like arrangement). The cocci have a compressed look, thus resembling Streptococcus VII. (*See* remarks under that heading.)

Plate cultures (under a low power of the microscope).

(*a*) Gelatine (20° C.). The colonies are irregular in shape and very transparent, and can readily be seen to be made up of an entanglement of loops without apparent beginning or end. No liquefaction.*

(*b*) Agar (20° C.). Here the same beautiful appearance is observed, the colonies being composed of a loose tangle of loops.

Gelatine streak cultures (20° C.).—The colonies are very transparent and of irregular shape, but are larger than those of most streptococci. No liquefaction.

Broth cultures (20° C.).—Absolutely clear broth; at foot of tube white fleecy, cumulus-like growth.

Litmus milk cultures (20° C.).—Distinct acidity, but no clot (8 day).

Remarks.—This microbe grew at 37° C., but better at 20° C. It resembled somewhat closely Streptococcus VII.

[? STREPTOCOCCUS X$_1$].

Source.—Agar plate culture (37° C.) containing 0·1 cc. of a 10 cc. "filter brushing" of 1,000 cc. *dilute soil water.* Soil VII. (Thames mud).

Morphology.—Stains well by Gram's method. Cocci in short chains but also in masses. Difficult, if not almost impossible, to say whether a streptococcus or a staphylococcus.

Plate cultures (under a low power of the microscope). Gelatine (20° C.).—The colonies are small and transparent looking, and show wavy granulation. They are circular in shape, and the edge has a somewhat frayed appearance. No liquefaction.

Gelatine streak cultures (20° C.).—The colonies are fairly small and separate, but are perhaps more opaque than is usually the case with streptococci. No liquefaction.

Broth cultures (37° C.).—The liquid remains quite clear; on the sides of the tube and at the foot a white streaky veil-like growth develops, of a tenacious consistence.

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* Figs. 11, Plate XXXIV, and 12, Plate XXXV.

Litmus milk cultures (37° C.).—Practically no change in four days. Later, acidity without clot (8 day).

Remarks.—Resembles both a streptococcus and a staphylococcus. Perhaps, on the whole, most like a streptococcus.

STREPTOCOCCUS XI.

Source.—Agar plate culture (37° C.) containing 0·1 cc. of a 10 cc. "filter brushing" of 1,000 cc. *dilute soil water.* Soil XIV. (sewage field).

Morphology.—Stains well by Gram's method. A streptococcus forming short chains.

Plate cultures.—(Under a low power of the microscope).

(*a*) Gelatine (20° C.). Minute transparent nearly circular colonies with *clean* edge. No liquefaction.

(*b*) Agar (37° C.). Very small and faintly granular colonies; transparent nearly circular with *clean* edge.

Gelatine streak cultures (20° C.). The colonies are separate, small, and transparent. No liquefaction.

Broth cultures (37° C.).—Diffuse cloudiness.

Litmus milk cultures (37° C.)—Strong acidity, but no clot (5 days).

Remarks.—Two mice were inoculated subcutaneously each with 1 cc. of a 24 hrs. broth culture. They remained apparently unaffected.

The bacteriological results are shown diagrammatically in diagram 2 (at end of this Report).

CONCLUDING REMARKS.

When, for the sake of forming an approximate estimate of the value of the chemical and bacteriological results of this inquiry, we compare *averages* in each instance, we find :—

That the *eight virgin soils* yielded as regards their "washings," the following results.

Chemically the average results were :—0·009, 0·0332, 0·4798 pts. per 100,000 respectively of free ammonia, albuminoid ammonia, and oxygen absorbed from permanganate (*medium soil water*).

Bacteriologically the average results were as follows :—1,157 bacteria in 1 cc., *no* B. coli (or closely allied forms) in 0·1 cc., *no* spores of B. enteritidis sporogenes even in 10 cc., and *no* streptococci in 0·1 cc. (*medium soil water*).

That the *seven polluted soils* yielded as regards their "washings" the following results :—

Chemically the average results were :—0·01542, 0·0246, 0·1512 pts. per 100,000 respectively of free ammonia, albuminoid ammonia, and oxygen absorbed from permanganate (*medium soil water*).

Bacteriologically the average results were as follows:—389 bacteria in 1 cc., B. coli (or closely allied forms) present in 0·1 cc. of a 10 cc. "filter brushing" of 1,000 cc. in four out of the seven soils. Spores of B. enteritidis sporogenes present in 1·0 cc. of a 10 cc. "filter brushing" of 1,000 cc. in five out of the seven soils.* Streptococci present in 0·1 cc. of a 10 cc. filter brushing of 1,000 cc. in four out of the seven soils (*dilute soil water by the filter brushing method*).

Looking to the whole of the three years' inquiry on this subject, the facts obtained seem to me to warrant the following conclusions:—

Chemical considerations:—

Soils containing a large proportion of vegetable organic matter, a small proportion of inorganic substances, and little or no animal matters are apt to yield "higher" results as regards albuminoid ammonia and oxygen absorbed from organic matter than soils containing a large proportion of inorganic substances, a small proportion of vegetable organic matter, but yet *saturated* with *animal matters* of *excremental origin.*

"Washings" from soils enormously and dangerously polluted might up to a certain amount contaminate a water and not be chemically appreciable: yet the same contamination would yield to bacterial examination *unequivocal proof* of its *objectionable origin.*

The chemical distinction between animal and vegetable organic matter is largely conjectural in character and fails to define the relative proportions of the different kinds of organic matter present in a substance.

Bacteriological considerations:—

Virgin soils do not contain spores of B. enteritidis sporogenes, B. coli (or closely allied forms), or streptococci, or at most they contain these microbes only in small number.

Soils polluted with animal organic matter contain spores of B. enteritidis sporogenes in great abundance, and also B. coli and streptococci if the contamination is of *recent* sort.

The total number of bacteria in virgin soils is much smaller than in the case of polluted soils.

The recent derivation of a water from the "washings" of soils can readily be detected by the presence in it of soil microbes (*e.g.*, B. mycoides, granular bacillus, cladothrix), and by the large number of spores (actually and relatively to the total bacterial flora) of aërobic bacteria.

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[*] As regards the two apparent exceptions: the spores of B. enteritidis sporogenes were present in 2·0 cc. of a 10 cc. "filter brushing" of 1,000 cc. *dilute soil water* in the one case. In the other, although a negative result was obtained when working with the *dilute soil water*, a positive result was got with a minimal quantity (0·1 cc.) of the *medium soil water.*

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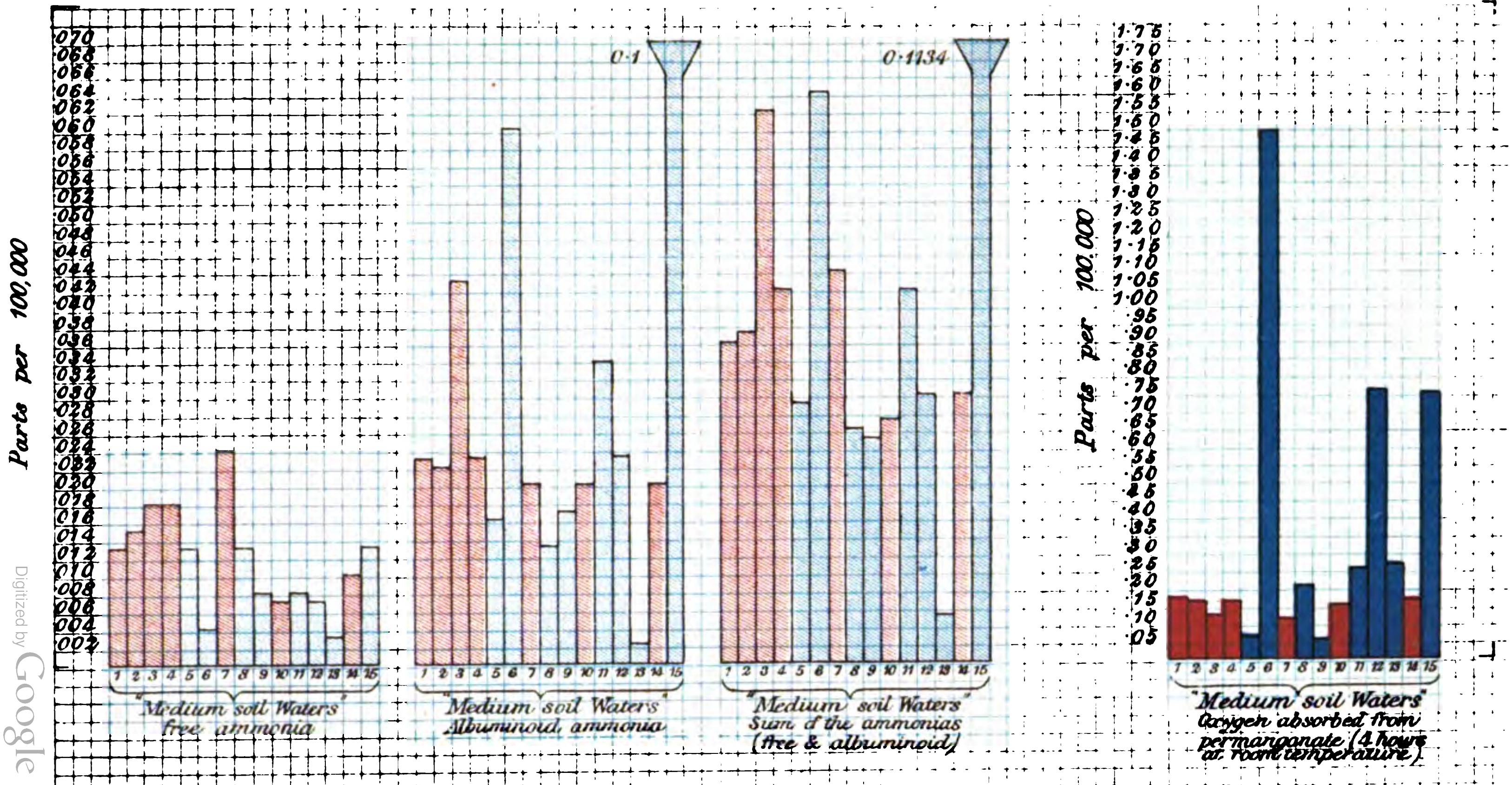
On the Chemical and Bacteriological Examination of "Washings" of Soils; by Dr. Houston.

What indications may these considerations afford to the epidemiologist?

It means that chemistry cannot always be relied on to detect in a water supply the presence of "flood water," much less of "flood water" of objectionable or dangerous sort, but that bacteriology is capable of appreciating admixture of "flood water" in comparatively small amount. The presence or absence of spores of B. enteritidis sporogenes further enables the bacteriologist to draw a distinction between "flood water" derived from soils at one time or another polluted with excremental matters and that which has come from soils free from present or past contamination of objectionable sort. Lastly, the presence or absence of B. coli (or closely allied forms) and streptococci allows the bacteriologist to say whether there is or is not trustworthy evidence that the "flood water" has been derived from soils *recently* polluted with matters of animal outcome.

DIAGRAM I *showing, as regards free Ammonia, Albuminoid Ammonia, sum of the ammonias (free & albuminoid), and oxygen absorbed from permanganate, the results of the chemical examination of the various "soil waters" (medium soil waters).*



The red Colouring refers to the polluted Soils (1 2 3 4 7 10 & 14) & the blue Colouring to the Virgin Soils (5 6 8 9 11 12 13 & 15)

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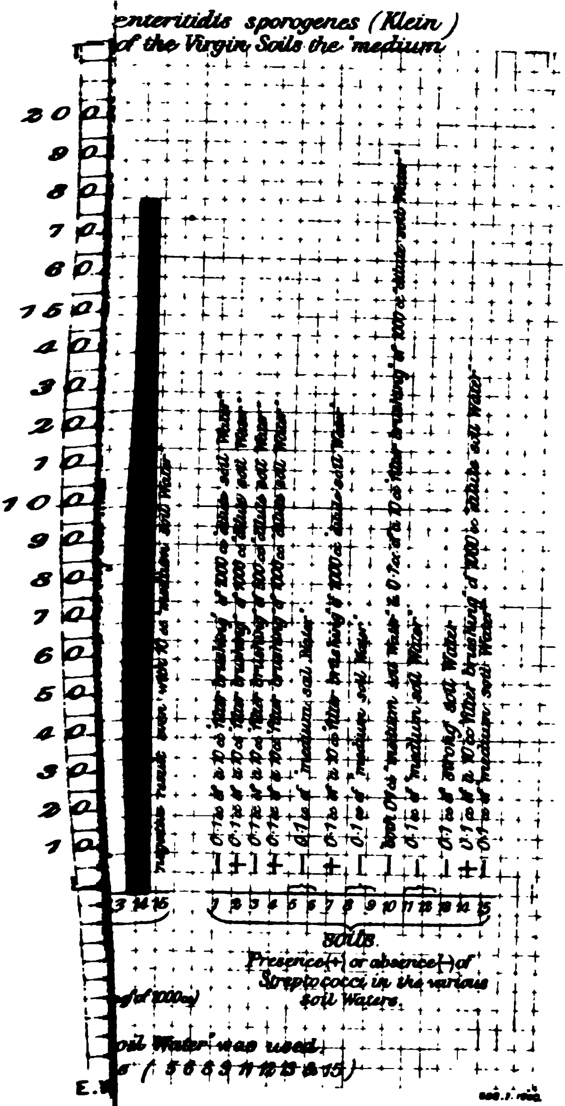
E. Weller & Grahams, Ltd Litho. London.



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APP. B, No. 5.

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Bacillus in Soi
by Dr. Martin
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No. 5.

FURTHER REPORT on the GROWTH of the TYPHOID BACILLUS in SOIL; by DR. SIDNEY MARTIN, F.R.S.

APP. B, No. 5.

On the growth of the Typhoid Bacillus in Soil: by Dr. Martin, F.R.S.

In previous reports it has been shown that the typhoid bacillus under certain conditions will grow in particular kinds of sterilized soil. In such soil as is obtained from cultivated areas, gardens, and the surroundings of houses, after sterilization, the bacillus, even if inoculated in small quantity, will live and multiply, gradually pervading the whole extent of the soil. The conditions favourable to this result are the presence of a certain amount of water and also of the organic matter which is present in such cultivated soils. On the other hand, it was found that in what may be called "virgin" soils—*i.e.*, soils mostly sandy and peaty, which had never been under cultivation or been manured—the bacillus would not grow and rapidly died out, even in the course of two or three days. There is a marked difference therefore between these two classes of soils when used in a sterilized condition—*i.e.*, in the absence of other bacteria—as culture media for the typhoid bacillus. The vitality of the bacillus in the favourable sterile soils was remarkable. It was found alive more than a year after the experiments were begun, and after this interval the soil could be dried at a low temperature (not above 40° C.) so that it could be powdered, with the result that the bacillus still, for a short time, retained its vitality. The experiments with the bacillus in sterilized soil were, however, only preliminary to a more important investigation which had as its object the determination of the conditions, if any, under which the typhoid bacillus might live in soils of one kind and another under natural conditions and necessarily unsterilized. Soils, more particularly those which have been cultivated and manured, contain numerous bacteria; äerobic and anäerobic. Many of them cause putrefaction; many are spore-bearing. The presence of these bacteria in soil puts quite a different complexion on the research when the typhoid bacillus is added to such soil with the view of studying its behaviour. Antagonism between these bacteria and the typhoid bacillus has now to be reckoned with, and the presence of these bacteria adds enormously to the difficulty of the research.

In several experiments described in my last report attempts were made to recover the typhoid bacillus after it had been added to unsterilized soils, which in the sterilized condition were found favourable to the growth of the bacillus. In not a single instance however was the typhoid bacillus regained, although laborious and prolonged experiments were made with this object. The obvious conclusion, therefore, was that, under the conditions of the experiments, the presence of the bacteria of the soil had either prevented the detection of the bacillus or had inhibited its growth and so led to its ultimate death and disappearance. It must be remembered that the typhoid bacillus does not form spores, so that its continued vitality depends on its power of multiplication and division. There is no resting stage of this micro-organism, as far as is known, and although in sterilized soil the bacillus will retain its vitality for a while if the soil be dried at a low temperature to a powder, yet soon afterwards it dies and can never be re-vivified. Placed, therefore, amidst other bacteria under certain conditions of moisture and temperature, the bacillus may in unsterilized soil be beaten out of the field by the other bacteria present. In my last report several experiments on these lines were recorded. The method of procedure was as follows:—The soil bacteria were isolated and their several characteristics in culture were studied. The growth of each bacterium in the presence of the typhoid bacillus was then tested by inoculating the two micro-organisms into media. The media were of two kinds, a liquid medium consisting of 200 cc. of sterile distilled water to which 10 cc. of broth had been added, and a solid medium composed of the soil from which the bacterium had been isolated, sterilized before being used for experiment and kept during the experiment in a moistened but not sloppy condition. In each case experiments were made both at the temperature of the outside air and at the temperature of the incubator. Without going into the details, it may be said that the results obtained in the main showed that both in the liquid and solid media employed, and as well at a low temperature as at 37° C., there are not a few soil bacteria, the growth of which inhibits the growth of the typhoid bacillus; in some instances so effectually that the bacillus is no longer recoverable, *i.e.*, it dies. These experiments were performed under simple conditions in which individual bacteria from the soil were, so to speak, pitted against the typhoid bacillus. It was found that more than one bacterium from a particular soil had this property of beating out the typhoid bacillus. On the other hand, it was found in some instances that the typhoid bacillus was more active in its growth at one or other temperature than the soil organism. The problem of the growth of the bacillus under actual conditions in the soil is therefore a complicated one, and appears from the above results to depend mainly on the kind of bacteria present in the particular soil, as well as on certain special conditions of temperature and moisture; and this will be the subject of remark later.

Further experiments have been made during the past year on the interaction of the soil organisms and the typhoid bacillus under simple conditions, and these may first be detailed.

GROWTH OF TYPHOID BACILLUS IN COMPETITION WITH INDIVIDUAL BACTERIA.

Nine different bacteria (all bacilli and äerobic) were isolated from a sample of soil (W.) obtained from an estate in Essex. The cultural characteristics of each bacillus were studied, but no effort was made to identify the species in each instance, as such a labour would have been beyond the scope of this research. The bacilli were labelled 1–9, and will be so referred to in the description of the experiments. Two organisms were selected for experiment: W. (1) and (4).

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On the growth of the Typhoid Bacillus in Soil; by Dr. Martin, F.R.S.

EXPERIMENTS WITH W. (1) AND THE TYPHOID BACILLUS.

W. (1) was a micro-organism which in its cultural and other characteristics showed a marked contrast to the typhoid bacillus, and was selected for experiment by reason of this difference. Thus on the agar plate it formed largish raised, white, and dry colonies, which showed a well-marked wrinkled edge, contrasting strongly with the fluorescent round colonies of the typhoid bacillus. It was a very small motile bacillus, which grew readily in broth, making it turbid, forming a deposit, but producing no scum; it did not form indol. In glucose gelatine (shake) it grew copiously near the surface, which was liquefied, but it did not grow in the depth of the medium. It did not coagulate milk (in four days), and on potato it formed in four days only a filmy transparent growth, in both these characters resembling the typhoid bacillus. On the gelatine plate, however, it contrasted strongly with this bacillus, in that in 24 hours it formed very numerous granular colonies which rapidly liquefied the medium.

Experiment I.

W. (1) and the typhoid bacillus in liquid medium at 37° C. The liquid medium used was 200 cc. of distilled water, to which 10 cc. of peptone broth had been added, and this was inoculated with a loopful each of a 24 hours' old broth culture of the typhoid bacillus and of W. (1) (Flask A). A control flask (Flask B) containing a similar medium was inoculated with W. (1) alone.

In 24 hours Flask A was turbid while Flask B was clear. In two days, however, Flask B became turbid, and this turbidity increased somewhat, but was never so marked as in Flask A, which contained the typhoid bacillus as well as W. (1).

The fate of W. (1) when grown by itself at 37° C. in this medium may first be considered. When tested two days after inoculation by brushing some of the liquid over two agar plates, a pure culture of the micro-organism was obtained, the colonies showing the characteristic wrinkled margins. These colonies were subcultured in broth and subsequently on slope agar to test the purity of the growth: only one species of micro-organism was found, and it had the characters of W. (1). The flask was tested again in 28 days and was found to be sterile, as none of the characteristic colonies of W. (1) grew on the agar plate, only two colonies being observed, which were very different in character, and were no doubt due to contamination of the plate from the air. The bacillus had, therefore, a comparatively short life in this medium at a temperature of 37°; and the results of the examination of Flask B seemed to show that this duration of life was under 14 days.

Flask A was tested in two days after inoculation by brushing the liquid over two agar plates; a copious growth occurred along the brush marks in each plate in 24 hours, but the colonies appeared to be twofold in character. A long series of subcultures was therefore made from the plates to determine whether the typhoid bacillus was present. A subculture in broth from the plates showed motile rods and threads like the typhoid bacillus;

On the growth of the Typhoid Bacillus in Soil; by Dr. Martin, F.R.S.

a culture was made on slope agar, on which a copious growth appeared like the typhoid bacillus mixed with another micro-organism. Some of the broth was then spread over the surface of an agar plate with a platinum needle, and numerous fluorescent colonies developed which looked like those of the typhoid bacillus. These were subcultured in broth, which became turbid, and showed a deposit but no scum. From this broth further subcultures on agar, potato, milk, and glucose-gelatine were made. These subcultures showed the characters of the typhoid bacillus: a filmy growth formed on potato, milk was not coagulated, and a copious growth appeared in the glucose-gelatine, which was not liquefied and did not show gas formation. This bacillus gave the typhoid serum reaction in dilutions of 1 in 30 and 1 in 100. In testing therefore at the end of the first two days of the experiment both micro-organisms were found.

A second testing was performed at the end of 14 days and was carried out in a similar manner. It was found, however, that only colonies of the typhoid bacillus were obtained; none of the colonies resembled W. (1).

A third testing at the end of 28 days gave the same result, that is, demonstrating the presence of the typhoid bacillus and the absence of the organism called W. (1).

This experiment does not necessarily demonstrate that at the temperature of 37° C. the typhoid bacillus is inimical to the bacterium W. (1), but it may simply mean that at that temperature W. (1) does not live as long as the typhoid bacillus; and that this is probably the explanation is shown by the results of an exactly similar experiment carried out at the temperature of an outside shed in the winter (October to March) as follows:—

Experiment II.

The two flasks each contained 200 cc. of water and 10 cc. of broth. One (Flask A) was inoculated with W. (1) alone, and the other (Flask B) was inoculated with W. (1) and with the typhoid bacillus—a loopful of a broth culture in each case.

At the end of 7 days both flasks were very turbid, and the liquid being stroked over the surface of agar plates produced a copious growth quite unlike the typhoid bacillus. The growths from both flasks were alike, and that from Flask B was subcultured in broth; on agar, on which granular colonies developed; and on glucose gelatine, which showed a surface growth like W. (1). The typhoid bacillus was in this instance not obtained at this stage from the flask into which it had been inoculated. In 14 days from the commencement of the experiment this Flask (B) was examined again, but no colonies of the typhoid bacillus were obtained, only those characteristic of W. (1). The typhoid bacillus had therefore disappeared. The relative rate of growth of these two micro-organisms, when mixed, at the two different temperatures is therefore very remarkable; at 37° the typhoid bacillus survived the other bacterium in a culture medium inoculated with both, and at the temperature of the outside air in the winter months the bacterium W. (1) outlived the typhoid bacillus.

Similar experiments were performed with another micro-organism—a motile bacillus—from the same soil. It is designated W. (4):—

EXPERIMENTS WITH W. (4) AND THE TYPHOID BACILLUS.

W. (4) was a small slender motile bacillus showing plasmolysis when stained with carbol-fuchsin. Although microscopically it could not be mistaken for the typhoid bacillus, and gave on agar plate a characteristic large colony with a brown centre and a translucent edge (thus contrasting with the typhoid bacillus), yet in cultivation on other ordinary media it closely resembled that bacillus. Thus in broth it caused a turbidity with a deposit and formed no indol; in glucose gelatine it grew chiefly near the surface, but caused no liquefaction; it did not coagulate milk; it gave a slight transparent growth on potato; on gelatine plate the colonies were indistinguishable from those of the typhoid bacillus. From this bacillus, however, it was to be distinguished partly by its microscopical characters, but mainly by its colonies on agar plate, and by its negative reaction with typhoid serum.

Experiment III. (at 37° C).

Two flasks, each containing 200cc. water and 10cc. of broth. One (Flask A) inoculated with a loopful of broth culture of W. (4) alone; the other (Flask B) inoculated with a loopful each of broth culture of W. (4) and of the typhoid bacillus. The flasks were kept in the incubator at 37° C.

In twenty-four hours Flask B was turbid, Flask A almost clear. In two days both flasks were turbid, B, however, more than A. Both were tested by being brushed over agar plates. A copious growth occurred on the plates in each instance; that from Flask A being characteristic of W. (4), that from Flask B being more like the typhoid bacillus. On making subcultures on agar of the growth from Flask B, it appeared that there were two micro-organisms present; on subculture in glucose gelatine, in milk, and on potato colonies appeared which in each instance were like those of the typhoid bacillus. These colonies might, however, have been a mixture of W. (4) and the typhoid bacillus, as both micro-organisms have the same characteristics in the media mentioned. That the typhoid bacillus was the chief micro-organism present was, however, indicated by the fact that a well marked, although not complete, serum-reaction was obtained in dilutions of 1 in 30 and 1 in 100.

Subsequently, although both flasks became more turbid, a second testing performed at the end of 28 days showed that Flask A was sterile, no growth being obtainable by brushing the liquid over the agar plate; while Flask B showed, by the same means, that it contained a pure growth of the typhoid bacillus. This growth was subcultured in broth, on agar, glucose gelatine, and in milk, and in each instance it behaved like the typhoid bacillus; moreover it gave a positive serum-reaction in dilutions of 1 in 50. In this experiment therefore at 37° the bacillus called W. (4) died out while the typhoid bacillus survived.

Experiment IV. (at the temperature of the outside air).

A similar experiment was performed in an outside shed, a similar liquid medium being employed. Flask A was inoculated with W. (4) alone, Flask B with W. (4) and the typhoid bacillus. After seven days the liquid in each flask remained quite clear, there being no apparent growth; after 14 days Flask A showed a slight growth, while Flask B was still clear. There was, however, some deposit in Flask B in 22 days, when the liquid in both flasks was brushed over agar plates. From each flask a pure growth of W. (4) was obtained, and there was no colony from Flask B which resembled the typhoid bacillus. The organism W. (4) does not grow well at a low temperature, and the disappearance of the typhoid bacillus may in this instance have been due more to the fact that it was of weakened vitality than to any antagonistic effect the slight growth of W. (4) may have had on it.

Similar experiments were therefore performed with a culture of typhoid bacillus obtained from the spleen of a quite recent case of enteric fever. The virulence of this bacillus had been increased artificially by passage through guinea pigs, so that 1·5 cc. of an 8 hours culture of the peritoneal exudation of an experimental guinea pig was fatal to another animal in less than 24 hours.

Experiment V. (at 37° C).

Three flasks containing the same liquid medium as before were inoculated, one (A) with W. (4), a second (B) with the typhoid bacillus, a third (C) with W. (4) and the typhoid bacillus: a pipetteful of a broth culture of each micro-organism being used. The flasks were then placed in the incubator. In Flask A no growth occurred at all during the 16 days of the experiment. From Flasks B and C, in 24 hours, a pure growth on agar plates was obtained of the typhoid bacillus, which was subsequently cultivated in the various media, and was found to give a typical serum-reaction in dilutions of 1 in 100. Similar results were obtained on the 13th and 16th days of experiment. The result, therefore, was that at 37° the typhoid bacillus alone survived, while W. (4) did not grow at all, although it would grow readily if cultivated at 37° in ordinary peptone broth instead of the very diluted broth medium used in this experiment.

Experiment VI. (at the temperature of the outside air
in the winter months).

A similar experiment to the last, and with the same stock of cultures, was performed at a low temperature, and the results were the same. Tested after five days and after 14 days, the typhoid bacillus alone survived, the bacillus called W. (4) not developing at all.

These six experiments considered along with those recorded in my last Report show that the behaviour of the typhoid bacillus in the presence of one or other micro-organism separated from the soil depends as well upon the nature of the competing microbe as upon the temperature of experiment. In some cases, both in a

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liquid medium and in the solid medium of the sterilized soil, and alike at high and low temperature, the growth of the typhoid bacillus is so impeded that it eventually dies, the other micro-organism continuing to grow; and, so far as these experiments go, this would appear to be a common condition. In other cases, however, the typhoid bacillus survives while the other micro-organism disappears. In some instances this occurs only when the temperature of experiment is high, in others at low temperature also.

GROWTH OF THE TYPHOID BACILLUS IN UNSTERILIZED (NATURAL) SOILS.

In previous reports it has been shown that in certain soils, when sterilized, the typhoid bacillus grows readily, and remains active for a considerable time. These experiments which were preliminary to the investigation of the bacillus in soil in which the ordinary bacteria had not been killed by heat, had been performed under varying conditions of temperature (at 37°, at the temperature of the laboratory, about 15°–19° C., and at the temperature of an outside shed, 4°–10° C.); and in the presence of a certain amount of water, which made the soil moist without being sloppy. Exactly similar experiments, using, however, unsterilized soil, were then performed. The results published in my last Report were uniformly negative: in no instance was the typhoid bacillus regained from unsterilized soil, even where it had been added in large quantity. Now, in these experiments the soil, which contained a large proportion of water, would naturally be favourable to the growth of many other soil organisms as well as of the typhoid bacillus. And experiments on the growth of individual soil organisms along with the typhoid bacillus, suggested that the inability to recover the bacillus from the unsterilized soil might have been due to the fact that, in the circumstances of the experiments, rapid multiplication of the soil organisms had occurred and had prevented the development of the bacillus. This would be more likely to happen at 37° C. than at lower temperatures. That certain soil organisms do multiply rapidly at 37° C., when the soil is in a moist condition, is evidenced by investigating the number of colonies obtained from a perfectly fresh soil, without any previous treatment whatever, and comparing it with the number obtained after the same soil has been moistened and incubated at 37° for 24 hours. In the latter case, the number of colonies is vastly more than in the former. Notwithstanding that the typhoid bacillus, when in competition in a liquid medium with certain soil bacteria such as W. (1), appeared to be favoured by a high temperature, *e.g.*, 37° C., there was yet, on the whole, reason to think that the higher the temperature and the greater the amount of water present the more likely are the soil organisms to beat out the typhoid bacillus. Accordingly in the experiments to be recorded in this Report the behaviour of the typhoid bacillus has been studied in soils kept at comparatively low temperatures and in which the amount of water was very slight.

Methods used.—Before, however, dealing with these experiments it is necessary to describe the methods used for recovering the typhoid bacillus from the soil. When the soil contains only the typhoid bacillus this recovery is particularly easy, since simply incubating a small part of the soil in broth or in broth and water, and brushing the liquid after 12–24 hours over agar plates, will give a pure culture of the bacillus. The problem is, however, very different, and much more difficult if the soil is unsterilized and contains the organisms natural to it. As has been previously said, in seeking to recover the typhoid bacillus attention need only be paid to the äerobic bacteria, 10–15 different varieties of which are usually present in the ordinary soils (garden and cultivated soils) which when sterilized are favourable to the growth of the typhoid bacillus. These bacteria are all bacilli of varying size and with different characteristics; cocci were never found. Some are putrefactive micro-organisms, some are spore-bearing. The majority are by their mode of growth on agar plate, or by other cultural characteristics, to be readily distinguished from the typhoid bacillus: others are with difficulty so distinguished. In the latter case the typhoid bacillus has to be diagnosed finally by the number of flagella it shows, and by its characteristic serum reaction.

One method used in isolating the typhoid bacillus from soil was to add a small portion of the soil to 200 cc. of sterilized distilled water in a flask, and incubate it at 37° C. from 18–24 hours. This length of time is necessary to allow the bacillus to develop; if shorter times (6–8 hours) are allowed, it may not develop sufficiently to obtain a sub-culture, as I found when working on the growth of the bacillus in sterilized soil. After incubation the liquid is brushed with a sterile brush over the surface of 6 or 8 large agar plates, without recharging the brush. In this way after incubation isolated colonies are obtained on the plates brushed last, and these colonies can be examined under the microscope to detect those resembling the typhoid bacillus. There are, however, objections to this method, the chief of which is that some of the soil organisms (3 or 4 in each soil) develop more rapidly in the distilled water medium at 37° C. than the typhoid bacillus, so that when the liquid is "plated" nothing is seen but an extensive overgrowth of these colonies, frequently merged together. The typhoid bacillus might thus be present but not able to be isolated owing to the enormous number of other bacteria present. Another objection to this method is the question of the antagonism between soil organisms and the typhoid bacillus. It was, for example, to be inferred from experiments already recorded, that even in twenty-four hours the typhoid bacillus might not be recovered from a liquid medium to which it had been added together with certain species of soil organisms.

The same objections apply when the medium used is 10 cc. of broth added to the 200 cc. of water, and the incubation lasts twenty-four hours. Both these methods were therefore discarded as they might give rise to fallacious results.

The objections mentioned would apply more strongly to ordinary peptone broth incubated for 24 hours after the soil is added; such an enormous growth of bacteria takes place that the plates made from the broth, even after much dilution, are unworkable. The

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method which I have more recently adopted, however, is to use ordinary peptone broth in test tubes, to add a small portion of the soil to be tested, and to incubate the tube at 37° C. for four to six hours. At the end of this time the liquid is usually slightly turbid, sometimes, however, not apparently so; it is then brushed as in the other methods over the surface of six agar plates. The typhoid bacillus increases markedly in four to six hours in broth, and this short time of incubation does not, as the results of the experiments show, permit such a copious multiplication of the soil organisms as to obscure the presence of the typhoid bacillus on the agar plate. Each plate after 24 hours' incubation at 37° is examined under a low power of the microscope, and those colonies which by their shape or fluorescence even remotely resemble those of the typhoid bacillus are studied in detail. The amount of labour involved in one testing is therefore very great and usually extends over a period of three weeks. Each investigated colony is examined microscopically, and at the same time a culture is made in broth. This broth culture, after growing three or four days, is tested for indol, and from it, after 24 hours, sub-cultures are made on slope agar, in shake glucose gelatine, in milk, and on potato. If the characteristics in sub-culture are those of the typhoid bacillus, the organism is finally tested by determining the number of flagella, and by the typhoid serum reaction in dilutions of 1 in 50 and 1 in 100; a serum being used of known strength and a control experiment with a known typhoid bacillus being performed at the same time. The characters therefore relied upon for the diagnosis as the typhoid bacillus of a micro-organism obtained from the soil are the following:—

Microscopically.—An actively motile bacillus: long and short rods which, on staining with carbol-fuchsin, show an irregularity in their protoplasm, called plasmolysis; and which, with appropriate staining, show eight or more flagella.

In broth, a turbidity forms, and then a deposit, but never a serum. No indol is formed.

On agar plate.—A discrete medium sized colony, fluorescent by reflected light, translucent but not transparent by transmitted light; not granular in the centre, and not transparent nor fringed at the edge.

On slope agar.—Usually a diffuse fluorescent growth, with outlying discrete colonies resembling those on the agar plate.

In glucose gelatine (shake), a copious growth throughout the substance of the medium, looking often like ground glass; causing no liquefaction of the medium and no formation of bubbles of gas.

On the gelatine plate, discrete, uniformly brownish, small colonies which do not cause liquefaction.

In milk, a copious growth which does not coagulate even after a long time; as a rule 4–7 days being sufficiently long for the test.

On potato, a filmy transparent growth, sometimes brownish, which on microscopical examination shows long threads.

Serum-reaction.—A positive and well marked reaction in dilutions of 1 in 30, 1 in 50, and 1 in 100 of a serum obtained from a typhoid patient, which serum has previously been tested on a known culture of the typhoid bacillus.

None of the organisms naturally occurring in the experimental soils gave all these reactions. Sometimes the growth on the agar plates was a sufficient distinction from the typhoid bacillus: sometimes the liquefaction of the gelatine medium, sometimes the coagulation of milk or the growth on potato. In any case the final tests of the number of flagella or of the serum-reaction remain as distinctive of the typhoid bacillus.

The specimens of the typhoid bacillus used in the experiments to be recorded were all obtained directly from the spleen of patients just dead of the disease, and no old laboratory cultures were used. They were all subjected to the tests just described, and in all cases responded to the typical reactions of the bacillus.

The experiments will be described in the following way. Each soil (four of which were used) will be considered (1) as regards the number and variety of bacteria it contained on arrival at the laboratory; (2) as regards its power of serving when sterilized as a culture medium for the typhoid bacillus; and (3) as regards its effect on the bacillus when this is added to it in its natural state, *i.e.*, unsterilized.

From the considerations previously discussed, the experiments were made at a low temperature and in winter, viz., that of an outside shed, and in the presence of a minimum of moisture, as both these conditions, from previous experience, would seem to conduce to the vitality of the typhoid bacillus in the presence of other micro-organisms to a greater extent than a high temperature and much moisture.

EXPERIMENTS WITH SOIL I. (W.).

This was a dark loose granular soil from an estate in Essex. It was easily dried and powdered, and it was reduced to this condition for the purpose of the experiment.

Bacteria in Soil I. (W.).

Nine different colonies of bacteria were separated from the soil by the method previously described. These were isolated and in part studied. One was a sarcina (probably from the air), another was bacillus subtilis. The remaining seven were unnamed. The characters of these in relation to those of the typhoid bacillus were as follows:—

BACTERIA IN SOIL I. (W.).

Bacterium.	Agar Plate.	Agar, Slope.	Broth.
No.			
(1)	Colonies, raised whitish, wrinkled edge.	Copious growth, dry, wrinkled edge.	Turbid, deposit, no scum, no indol.
(2)	Yellow, opaque, circular ..	Yellow, opaque ..	Clear, deposit, no scum, no indol.
(3)	Dark centre, wavy edge, (young colony)	Two micro-organisms, B. subtilis and transparent colonies.	No indol .. ..
(4)	Large colonies, brown centre, translucent edge.	Same as agar plate	Turbid, deposit, no scum, no indol.
(5)	Opaque, circular; with a fringe of fine processes all round.	Like (4)	Like (4) .. ..
(6)	Dark, opaque, circular, coarse granular processes around.	Only two colonies, grows badly.	Clear, deposit, no scum.
(7)	Circular, translucent, finely granular, smooth margin.	Translucent, small colonies.	Turbid, deposit, no scum, slight indol reaction.
(8)	Circular, brown centre, wavy edge.	Translucent round colonies.	Turbid, deposit, no scum.
(9)	Brown centre, regular margin	Same as (8)	Chiefly deposit, no scum.

Glucose Gelatine (Shake.)	Gelatine Plate.	Milk.	Potato.	Microscopical Appearances.
Surface growth, copious, liquified	In 24 hrs., numerous granular colonies, liquefaction.	Not coagulated (4 days).	Slight growth (4 days).	Very small motile bacillus.
Diffuse, not liquified	—	—	—	Sarcina lutea.
—	—	—	—	Bacillus subtilis and one other bacterium.
Surface growth, not liquefied.	Oval, brown colonies, not liquefying.	Not coagulated (4 days).	Slight growth (4 days)	Small, slender bacillus, motile, and showing plasmolysis.
Same	—	—	—	Like (4)
Diffuse growth, not liquefied	—	—	—	—
Diffuse, not liquefied	—	—	—	Very short bacillus with round ends.
Surface growth, liquefied.	—	—	—	Short bacillus, staining irregularly.
Diffuse growth, not liquefied.	—	—	—	—

By one or other of the characters enumerated above all these bacteria could be readily distinguished from the typhoid bacillus. All the above bacteria were äerobic; the anäerobic were not investigated.

Growth of the Typhoid Bacillus in soil I. (W.), sterilized.

Before experimenting with the natural soil, it was necessary to see whether the sterilized soil would serve as a culture medium for the typhoid bacillus.

Some of the soil was sterilized: the sterility being tested. The soil was placed in an Erlenmeyer flask and about 5 cc. of a 24 hours old broth culture of a virulent typhoid bacillus was added. The flask was kept at the temperature of an outside shed, the temperature being registered night and morning. During the first week the temperature varied between 3° and 8° C.; during the next 14 days between 6° and 12° C.; for the following period of the experiment, between 2° and 11° C. The temperature was therefore always low, never above 12°, and usually about 5° or 6° C.

The *first testing*, by the methods previously described was performed 24 hours after the typhoid bacillus had been added. On the agar plate, a pure growth of the bacillus was obtained, which in subculture and on microscopical examination showed all the characters of the typhoid bacillus.

The *second testing* at the end of 4 days gave also a pure growth of the bacillus.

The *third testing*, after 13 days, showed that there was some contamination as the broth developed a scum. This contamination probably came from the air during the frequent opening of the flask containing the soil. From the broth, however, by careful sub-culture, a pure growth was obtained, showing on agar, in glucose gelatine, in milk and on potato, as well as microscopically, the typical characters of the typhoid bacillus.

The *last testing*, after 57 days, showed that the flask still remained contaminated by a micro-organism which gave a scum in broth. But by using the agar plate, colonies of the typhoid bacillus were separated and then subcultured, showing all the characteristics of this micro-organism. On staining, also, numerous flagella were seen. No further testing was done as it had been proved that this W. soil, when sterilized, would serve as a culture medium for the bacillus for as long period as 57 days.

Growth of the Typhoid Bacillus in soil I. (W.), unsterilized, i.e. *in the Natural Condition.*

The soil after drying at a low temperature (below 40°) and powdering was placed in a glass capsule 3½ inches in diameter and to the depth of about ¼ inch. It was made just moist with distilled water: so that it did not form a coherent mass, nor was it mud.

It was inoculated in the centre from a pipette with 20 drops of a two days old broth culture of the typhoid bacillus, just obtained from the spleen of a case of typhoid fever.

The capsule was kept in an outside shed, covered with a glass plate. The temperature of the air during the experiment varied between 2° and 12° C.—it was, however, usually between 5° and 8° C.

First testing after 24 *hours.*—A portion of the soil from the centre was placed in a broth tube and incubated for six hours; a second portion being incubated in a mixture of 200 cc. water and 10 cc. broth for the same time. Each liquid was then brushed over two agar plates. In the plates from the broth there were many fluorescent colonies like those of the typhoid bacillus, two of which were subcultured in broth. But although they gave a growth like the typhoid bacillus on agar and potato and in milk, yet they both liquefied glucose gelatine, and so were considered not to be the typhoid bacillus. At this stage of the investigation sufficient attention was not paid to the fact that in making what was supposed to be a culture from a single colony on the agar plate there was great liability for the culture to become contaminated by the neighbouring colonies, in which case one may really have in the broth a mixed culture of the typhoid bacillus and another bacterium and so be liable to miss the former.

The plates from the broth and water showed many discrete colonies like those of the typhoid bacillus, which microscopically were considered typical. In broth these colonies caused a turbidity and a deposit, but no scum; they also formed no indol. On agar and in glucose gelatine they grew like the typhoid bacillus; they did not coagulate milk, and they formed a filmy growth on potato. They were colonies of the typhoid bacillus.

Second testing after five days.—A portion of the soil was placed in a broth tube, incubated for 4½ hours at 37°, and then brushed over the surface of three agar plates. A copious growth of different bacteria was obtained, and of these four colonies which appeared like those of the typhoid bacillus were cultivated in broth. All four cultures were similar; the broth became turbid and there was a deposit but no scum; the bacilli were actively motile and, microscopically, resembled the typhoid bacillus. On agar subculture from the broth the growth was pure, and, on staining, the bacilli showed numerous flagella. A copious growth occurred in glucose gelatine without liquefaction or the formation of gas. Milk was not coagulated, and a filmy growth occurred in potato. All the colonies were those of the typhoid bacillus, and there was no difficulty in recognizing them from the above tests.

Third testing after 12 *days.*—Soil in broth 5½ hours at 37°, then brushed over three agar plates. [In 24 hours the broth was stinking, showing the abundant development of putrefactive bacteria.]

Plate A showed a growth along each streak of the brush, consisting of four or five different bacteria. None of the colonies even remotely resembled those of the typhoid bacillus.

APP. B, No. 5.

On the growth of the Typhoid Bacillus in Soil; by Dr. Martin, F.R.S.

Plate B gave a similar appearance, but in addition there were over 20 discrete colonies closely resembling those of the typhoid bacillus; three of them were cultivated in broth, referred to afterwards as (1), (2), (3).

Plate C consisted mainly of the bacillus called W. (6), but showed also about 20 colonies like those of the typhoid bacillus; one of them, referred to afterwards as (4), was cultivated in broth.

These broth cultures were examined microscopically and subcultures in the various media made. The results are shown in the following table:—

Colony.	Broth.	Agar.	Glucose Gelatine.	Milk.	Potato.
(1)	Turbid, deposit, no scum, no indol.	Pure fluorescent, flagella 5–8.	Diffuse, no gas, not liquefied.	Not coagulated, 7 days.	No apparent growth.
(2)	Very turbid, deposit, scum.	In 24 hours, apparently pure, fluorescent.	Growth chiefly at surface.	Coagulated and digested, 2 days.	White opaque growth.
(3)	Like (1) ..	Like (1). Flagella numerous.	Like (1) ..	Like (1) ..	Like (1).
(4)	Like (1) and (3)	Like (1) and (3)	Like (1) and (3).	Like (1) and (3).	Like (1) and (3).

Colonies 1, 3, 4 resembled those of the typhoid bacillus, and colony (1), when tested with a known typhoid serum, gave a positive reaction in dilution of 1 in 30, the result being contrasted with the reaction of the same serum with a known culture of the typhoid bacillus. All these three colonies were, therefore, those of the typhoid bacillus. Colony (2) also consisted of the same bacillus; but it was a mixed growth, which is often difficult to avoid in separating a single colony from the surrounding ones on a plate. By careful subculture the typhoid bacillus was separated from the broth of colony (2), and when grown in broth formed no scum; in milk produced no coagulation; and in the gelatine plate produced a growth typical of typhoid bacillus.

Fourth testing after 20 *days.*—Soil was incubated in broth tube for seven hours at 37°; broth then brushed over three plates. There was a copious growth on each plate, and all the plates stank. This was not the case with the plates in the previous testing, so that by the twentieth day the putrefactive bacteria had greatly increased. Two of the plates showed no colonies like those of the typhoid bacillus; on the third plate there were several fluorescent colonies, and two broth cultures were made from these. Microscopically the growth in the broth and water medium was unlike the typhoid bacillus. In broth a scum was formed, and on agar the growth was opaque, unlike that of the typhoid bacillus; in glucose gelatine a diffuse growth occurred without gas formation or liquefaction; milk was coagulated, and on potato a whitish yellow opaque growth formed. These colonies were, therefore, not those of the typhoid bacillus. The bacillus was, then, not found in the soil at the fourth testing after 20 days, and it may be noted that at this period there was a great increase in the number of the putrefactive bacteria.

Fifth testing after 48 *days.*—Later on a last testing was done to compare with the fourth. Soil incubated in broth tube 4 hours 50 minutes, at 37° : broth brushed over four agar plates. In the first two plates there was an abundant growth of three bacteria, a form of proteus, bacillus subtilis, and a third very characteristic bacillus the colonies of which grow in the form of fingers; none of the colonies were like those of the typhoid bacillus. The third plate showed only four colonies, all unlike the typhoid bacillus. On the fourth plate, besides other bacteria, there were two groups of discrete and slightly fluorescent colonies; these were cultivated in broth. One of these broth cultures showed a reticulated scum in two days, and on subculture showed the following characteristics : on agar, a diffuse growth, opaque, with digitate edges; on potato, a dirty white moist growth ; in glucose gelatine, a surface growth only; milk was coagulated in two days. The second broth culture showed no scum ; subculture on agar showed a diffuse opaque growth ; in glucose gelatine, a surface growth ; milk was coagulated in two days. Neither of the cultures, therefore, showed the presence of the typhoid bacillus.

Summary of the Results of the Experiments with Soil W.

A loosely granular soil from an estate under cultivation.

In the sterilized soil the typhoid bacillus was found to be alive 57 days after it had been added.

In the unsterilized soil the typhoid bacillus was found on the first, fifth, and twelfth days after it was added, but was not found on the twentieth day nor on the forty-eighth day. Both experiments were done at a low temperature—2° to 12° C., and in the case of the unsterilized soil there was very little moisture present.

In the unsterilized soil there was no evidence of increase of the bacillus, *i.e.*, of its spreading into the parts surrounding the area where it had been added. After five days, however, it was easier to find the bacillus than after 24 hours, so that it had probably multiplied to some extent.

EXPERIMENTS WITH SOIL II. (CR.).

Some importance was attached to the investigation of the behaviour of the typhoid bacillus in this soil, as it came from the same estate in Hampshire from which were obtained the "virgin" soils, experiments with which were described in my first Report. These virgin soils had never been cultivated, they were sandy and peaty and covered with heather ; and in them the typhoid bacillus would not grow, even if the soil were sterilized. The soil under consideration (Soil II.) came from the adjoining land, which was originally covered with heather ; it had, however, been sown with grass and "dressed" for several years, so that what was originally a virgin soil became a cultivated one. As received it was permeated with the roots of grasses.

App. B, No. 5.

On the growth of the Typhoid Bacillus in Soil; by Dr. Martin, F.R.S.

Bacteria in Soil II. (Cr.).

From this soil 14 different äerobic bacteria were isolated, a number in great contrast to that obtained from the "virgin" soils in the neighbourhood, which are nearly sterile. Of these 14 bacteria, each showed one or another characteristic (microscopical or cultural) which readily distinguished it from the typhoid bacillus; the characters which were noted are given in the following table:—

BACTERIA IN SOIL II. (Cr.).

Colonies.	Agar Plate.	Agar.	Broth.	Milk.	Glucose Gelatine.	Potato.	Microscopical Appearances.
No. (1)	Small, round, translucent.	Rather scaly	Deposit only. *Indol reaction*, +	Not coagulated, 7 days.	Diffuse growth.	Pinkish red, fleshy.	Bacillus.
(2)	Flat, with round edge, powdery.	—	—	—	—	—	—
(3)	Like (1) ..	Dryish, reddish, clear edge.	Turbid, deposit, scum. *Indol*, 0.	Coagulated	Surface only.	Pinkish red, fleshy.	Small lanceolate bacillus: spores.
(4)	Opaque, with clear edge.	Dry, opaque, scaly.	Flakes only. *Indol*, +	Coagulated and digested.	Surface, liquified.	Brownish red, ridged.	—
(5)	Like (10) ..	White, opaque, spreading.	Turbid, deposit, scum. *Indol*, +	Coagulated and digested.	Surface, liquified.	Moist, dirty red.	—
(6)	Opaque centre, crinkled edge.	Diffuse, opaque.	Turbid, deposit, little scum. *Indol*, 0.	—	—	—	—
(7)	Ramifying threads.	Felted growth	Scum, deposit. *Indol*, 0.	—	—	—	—
(8)	Small, translucent.	Translucent at first, opaque afterwards.	Scum, deposit. *Indol*, (?).	—	—	—	Short bacillus, square ends.
(9)	Like (1) and (13).	Fluorescent streak.	Tenacious deposit. *Indol*, 0.	Coagulated	Surface	Raised, dirty pink.	Very small bacillus, coccus-like.
(10)	Opaque, digitate.	Same as agar plate.	Turbid, deposit. *Indol*, 0.	—	—	—	—
(11)	Small, translucent.	Fluorescent streak.	Turbid, deposit. *Indol*, 0.	Not coagulated.	Surface	Same as (9)	Like (9).
(12)	Fleshy, crenated edge, radial striation.	Opaque, becoming yellow.	Turbid, deposit. *Indol*, +	—	—	—	—
(13)	Round, translucent, slightly fluorescent.	Fluorescent streak.	Slight deposit. *Indol*, 0.	Loosely coagulated.	Surface	Fleshy, dirty pink.	Small oval bacillus.
(14)	Opaque, white	Fluorescent streak (24 hours).	Turbid, deposit. *Indol*, 0.	Coagulated	Surface	Pinkish red, fleshy.	—

A reference to this table shows that by one or other character each of these bacilli could be readily distinguished from the typhoid bacillus; which was the point aimed at in studying them.

Growth of the Typhoid Bacillus in Soil II. (Cr.), sterilized.

The soil was placed in a Erlenmeyer flask, sterilized, and the sterility tested. It was inoculated in the centre with a large pipetteful of a broth culture of virulent typhoid bacilli. The soil was dryish and crumbly.

First testing after 24 *hours.*—By the method previously described a pure growth of the typhoid bacillus was obtained which gave all the tests of this bacillus.

Second testing after 4 *days.*—The bacillus was obtained in pure growth and gave all the tests.

Third testing after 13 *days.*—The bacillus was obtained in pure growth; but, microscopically, it appeared to be degenerating, *i.e.*, becoming broken up and the rods showing extensive plasmolysis by staining.

Fourth testing after 57 *days.*—No growth of any kind was obtained from the soil; it had become sterile.

This result is in contrast with sterilized soil W, from which, at the end of 57 days, the typhoid bacillus was still to be obtained.

Growth of the Typhoid Bacillus in Soil II. (Cr.), unsterilized.

This experiment was performed in the same way as the similar experiment with Soil I. (W). The soil in glass capsules was inoculated in the centre with 20 drops of a broth culture of virulent typhoid bacilli, and then was kept at a temperature of 2°–12° C. in an outside shed. The method of testing was the same as before and the details need not be repeated; a small portion of the soil being incubated at 37° in a broth tube for 4 to 7 hours and this broth then brushed over 3 or 4 agar plates, from which colonies resembling those of the typhoid bacillus were subcultured in broth and further examined.

First testing after 24 *hours.*—Three plates were made, two of which showed no colonies like the typhoid bacillus; the third, however, showed many discute fluorescent colonies which on microscopical examination and on subculture in broth, milk, glucose gelatine, agar, and potato proved to be those of the typhoid bacillus.

Second testing after 5 *days.*—Three plates made; one showed no growth at all, another showed no colony like that of the typhoid bacillus; the third showed several fluorescent colonies, two of which were subcultured in broth. In this medium—as well as in milk, glucose gelatine, agar, and potato—and microscopically, the reactions were those of the typhoid bacillus.

Third testing after 12 *days.*—Three plates made; one showed very few colonies, none of them like the typhoid bacillus; the second showed a copious growth chiefly of the bacilli called Cr. (7) and (14), and also three groups of colonies like the typhoid bacillus. Subcultures in broth were made from colonies of each of these three groups. The third plate showed chiefly growths of Cr. (7), (10), and (14); and two groups of colonies like the typhoid bacillus; one of which was examined in subculture. Of the four groups of colonies thus examined in subculture, one proved not to be the typhoid bacillus, since it formed a scum in broth and coagulated milk; the other three were subjected to an extended examination, and gave all the cultural characteristics of the typhoid bacillus; microscopically also in each instance they were like the bacillus and possessed numerous flagella. One group was tested with typhoid serum, and a positive reaction obtained (dilution 1 in 50), the result being controlled by an experiment with the same serum and a known culture of the typhoid bacillus.

Fourth testing after 20 *days.*—Three plates made; two stank, and showed no colonies like the typhoid bacillus; the third showed a few fluorescent colonies, and three of these were subcultured in broth. An extended examination, however, revealed that none of these colonies were those of the typhoid bacillus; they consisted of Cr. (10) and (4), and were readily distinguished from the typhoid bacillus either by the liquefaction of glucose gelatine, by the coagulation of milk, or by the formation of a scum in broth.

The typhoid bacillus was, therefore, not recovered from the soil in the fourth testing after 20 days.

Fifth testing after 48 *days.*—Four plates made; three showed a large growth of soil organisms, but none resembling the typhoid bacillus; the fourth showed a small group of fluorescent colonies, which were subcultured in broth. Miscroscopically the growth consisted of large angular rods, staining uniformly with fuchsin, and thus unlike the typhoid bacillus. On potato, there was a dirty white growth in 24 hours, and milk was coagulated in two days. The colonies were not those of the typhoid bacillus.

Summary of Results of the Experiments with Soil II. (*Cr.*).

A sandy and peaty soil which had been "dressed" and grown with grass. A neighbouring soil which had not been cultivated, but was otherwise similar, was found previously to be inimical to the growth and vitality of the typhoid bacillus. The cultivated soil maintained the vitality of the typhoid bacillus for a short period (over 13 days) when sterilized, but not nearly for so long a period as sterilized garden soil was found to do. When unsterilized, the vitality of the bacillus was maintained in it for a period of 12 days; after 20 days it had, however, disappeared, and did not reappear after 48 days.

EXPERIMENTS WITH SOIL III. (N).

This was a garden soil, dark and crumbly, like other garden soils containing a large number of micro-organisms. Some of these bacteria were putrefactive, but the soil itself had only the smell of garden earth, and no putrefactive odour.

Growth of the Typhoid Bacillus in Soil III. (N), *sterilized.*

The soil was placed in glass capsules 3½ inches in diameter to the depth of about ¾ inch. It was made just moist, and to the centre was added 20 drops of a two days old culture of virulent typhoid bacilli. The capsule was kept at a temperature of 2° to 12° C.

First testing after 24 hours.—On the plates a pure growth of the typhoid bacillus was obtained, the diagnosis being confirmed by subsequent microscopical examination and by subculture on the various media, as in the previously recorded experiments.

Second testing after 12 days.—The plates showed a pure fluorescent growth of the typhoid bacillus, and the subsequent tests confirmed the diagnosis.

Third testing after 30 days.—A pure growth of the typhoid bacillus was obtained and confirmed as before. It grew as vigourously at the end of 30 days as before it was added to the soil.

No further testing was performed; the experiment showed that, when sterilized, Soil III. served as a culture medium for the typhoid bacillus.

Growth of the Typhoid Bacillus in Soil III. (N), *unsterilized.*

The soil was placed in capsules similar to those used in the last experiment. It was granular and dryish, and 5 cc. of a broth culture of virulent typhoid bacilli were added. The soil did not absorb the liquid well for some time. The capsule was kept at a temperature varying between 2° and 12° C. in an outside shed.

First testing after two days, by same method as before. Four agar plates were made from the broth, and showed the following results on examination. Two of the plates smelt of decomposition.

Plate A showed a copious growth of many bacteria; there were many colonies like those of the typhoid bacillus; two of these (referred to as colonies (1) and (2)) were cultivated in broth.

Plate B.—Along three of the brush strokes, the chief growth was of opaque digitate colonies; at the end of one of the strokes were two groups of colonies, very numerous, and like those of the typhoid bacillus; two of these were cultivated in broth, (colonies (3) and (4)).

Plate C showed very numerous colonies like the typhoid bacillus; four were cultivated in broth, (colonies (5), (6), (7), (8)).

Plate D.—Very much overgrown with ordinary soil bacteria, except in one spot, where there were colonies like the typhoid bacillus; these were cultivated in broth, (colony (9)).

Colony (9) gave a scum in broth; and so was not further investigated. Colony (7) gave a growth in glucose gelatine unlike that of the typhoid bacillus. The other colonies (1–6 and 8) were all alike microscopically and in cultivation; they were colonies of the typhoid bacillus. In broth they caused a turbidity and a deposit, but no scum and no indol were formed. Microscopically there were actively motile bacilli and threads, showing plasmolysis. On agar, they gave a pure fluorescent growth, and on staining, showed numerous flagella. In glucose gelatine, there was a diffused growth, but with no gas formation and no liquefaction. Milk was not coagulated in three days; and a filmy growth occurred in potato.

Second testing after ten days.—Four plates prepared.

Plate A showed a copious growth of soil organisms, but none like the typhoid bacillus.

Plate B showed very numerous discrete colonies resembling those of the typhoid bacillus; three cultures from these were made in broth, ((1), (2), (3)).

Plate C showed numerous colonies like those of the typhoid bacillus; one culture in broth was made, (4).

Plate D showed very few colonies like those of the typhoid bacillus. There was a slight smell of decomposition in all the plates.

Colony (4) was microscopically not like the typhoid bacillus; it coagulated milk and gave a yellow ochre-looking dry growth on potato. In broth it appeared to be a mixed growth of two micro-organisms, but they were not further investigated. Colonies (1), (2), (3) were microscopically like the typhoid bacillus and gave the typical reactions when cultivated in broth, agar, glucose gelatine, milk, and potato. Colony (1) tested for the typhoid serum reaction gave a positive result in dilutions of 1 in 30.

Results of the Experiments with Soil III. (N).

A garden soil not smelling of decomposition.

At the end of 30 days in the sterilized soil, at a temperature of 2° to 12° C., the typhoid bacillus was found alive and gave all its typical reactions. In the unsterilized soil it was found alive and in considerable quantity at the end of 10 days. The bacillus was after this interval readily separated from the soil by the method described, and was more abundant than in any of the other experiments with unsterilized soils.

EXPERIMENTS WITH SOIL IV. (E.)

This was also a garden soil without smell of decomposition. It was dark and somewhat sticky when moistened.

Like the other soils it contained a large number of aerobic organisms, some of which were putrefactive, but each of which, either by microscopical appearances or by the cultural characteristics in various media, was readily distinguished from the typhoid bacillus.

Growth of the Typhoid Bacillus in Soil IV. (E), *sterilized.*

Soil just moistened and in a flask to the depth of ¾ inch, was sterilized, the sterility being tested. It was inoculated in the centre with 20 drops of a two days old broth culture of virulent typhoid bacilli. The flasks were kept at a temperature of 2° to 12° C. in an outside shed.

First testing after 24 *hours.*—The plates showed an apparently pure growth of the typhoid bacillus. Examined microscopically, and cultivated on agar, potato, glucose gelatine, broth, and milk it gave all the reactions of the bacillus.

Second testing after 12 *days.*—A pure culture of the bacillus was obtained on the agar plates, and, subjected to the tests already described, proved to be the typhoid bacillus.

Third testing after 30 *days.*—Gave a similar result, all the tests being again applied.

At the end of 30 days the typhoid bacillus was alive and was obtained in pure cultivation.

Growth of the Typhoid Bacillus in Soil IV. (E), *unsterilized.*

The soil was placed in a glass capsule (as in the other experiments with unsterilized soil) to the depth of about ¾ inch, and was kept in a dryish condition. It was inoculated with one broth tube (about 5 cc.) of an 18 hours culture of virulent typhoid bacilli. The soil soaked it up well. The capsule was kept at a temperature of 2° to 12° C. in an outside shed.

First testing after two days.—Four agar plates made. There was no smell of decomposition in any of the plates.

Plate A showed, among others, many fluorescent colonies which were like those of the typhoid bacillus; three subcultures were made in broth, ((1) (2) (3)).

Plate B contained a few colonies like the typhoid bacillus.

Plate C showed a large number of colonies like the typhoid bacillus; three subcultures were made in broth, (4, 5, 6).

Plate D along one brush stroke showed many colonies like the typhoid bacillus; one subculture in broth was made, (7).

Colonies 1, 2, 3 developed scum in broth, and were not further investigated. The other colonies (4, 5, 6, 7) showed microscopically as well as in cultivation in the various media the typical reactions of the typhoid bacillus.

Second testing after 10 *days.*—Four agar plates made; slight smell of decomposition, showing increase in the number of putrefaction bacteria. The plates also showed much fewer colonies like the typhoid bacillus than the plates in the first testing.

Plate A showed a copious growth, mostly white colonies of one organism; no colonies like those of the typhoid bacillus.

Plate B showed the same as Plate A.

Plate C showed a large growth of soil organisms, but also several groups of colonies resembling those of the typhoid bacillus; three subcultures were made of these in broth, (1, 2, 3).

Plate D showed no colonies like those of the typhoid bacillus.

Colonies (2) and (3) were not those of the typhoid bacillus. Although both formed no scum and no indol in broth, yet colony (2) gave a yellow ochre-like growth on potato, and colony (3) coagulated milk in three days. Colony (1) responded to all the tests of the typhoid bacillus, both microscopical and cultural. It gave a definite reaction with dilutions of a typhoid serum of 1 in 30.

The typhoid bacillus, although present in the soil at the end of 10 days, was found in much smaller quantity than after the similar period in the case of Soil III.; and this notwithstanding that both soils had, when sterilized, served as good media for the cultivation of the bacillus.

General Summary of the Results obtained.

1. Certain cultivated soils, especially garden soils, when sterilized are favourable to the vitality and growth of the typhoid bacillus. Under comparable conditions other virgin or uncultivated soils do not support the bacillus, which rapidly dies. A previously virgin soil which had recently come under grass cultivation was used in the present experiments (Soil II. of this Report). This soil was found, when sterilized, to support the life of the bacillus for a certain period, but not nearly so long as the more definitely cultivated garden soils.

2. When the typhoid bacillus is added to unsterilized soils, kept very moist and at a temperature of about 19° to 37° C., it has not been possible to recover it from the soil, even after a short period, as was shown in my Report of last year. If, however, the soil be kept in a drier condition and at a low temperature (2° to 12° C.) as in this year's experiments, the bacillus can be regained after a certain interval, which in these experiments did not exceed 12 days. After this it appeared to die out.

3. The reason of the disappearance of the typhoid bacillus from the unsterilized soils appears to be the antagonism of some of the soil micro-organisms to its growth; and there is some evidence to show that, under the conditions of experiment, the disappearance of the bacillus has taken place *pari passu* with an increase in the number of the putrefactive bacteria.

4. As far as is known the typhoid bacillus has no resting stage. It has no spores, so that if it once dies it cannot be expected to reappear, unless a fresh inoculation occur.

No. 6.

REPORT on the CHEMICAL and BACTERIOLOGICAL EXAMINATION of SAMPLES of SOIL OBTAINED from the "FEVER" and "NON-FEVER" AREAS at CHICHESTER; by DR. A. C. HOUSTON.

Report on the Chemical and Bacteriological Examination of Samples of Soil; by Dr. Houston.

The city of Chichester is one of several localities in England and Wales where enteric fever is wont to be endemically prevalent in exceptional degree. This persistence of enteric fever in serious amount in Chichester has, on more than one occasion, formed the subject of investigation by the Local Government Board. In 1878, 1896 and 1899, the Local Government Board have received reports bearing on the prevalence of enteric fever in Chichester respectively from Dr. Airy, Dr. Bulstrode, and Dr. Thomson (jointly with Colonel Marsh).

In connexion with these enquiries, the points which appear to stand out in pre-eminence are that the prevalence of enteric fever in Chichester is not readily (if at all) to be associated with any of the agencies commonly regarded as having particular concern with the propagation of this disease, for example, bad drainage or impure water supply; and further, that the fever has shown a decided tendency to localise itself in particular areas. So much is this the case that certain portions of Chichester have come to be regarded as "fever areas," because the disease seems to display a special proclivity for these localities and tends to recur there; whereas other and more favoured portions are spoken of as "non-fever areas," because enteric fever does not occur, or only exceptionally appears in these localities. Yet, from Dr. Thomson's report, it would seem that neither in respect of class of property nor as regards drainage or water supply do these areas in general differ the one from the other so materially as to throw much light on the subject. Milk supply, which is so often concerned with outbreaks of enteric fever, could hardly be supposed to have caused a special prevalence of the disease, year after year, restricted to certain portions of the city. Speaking in general terms it may be said that although there have been "trails across the track," which have added to the difficulties of investigating particular epidemics, these have not obscured the main features of the problem. Thus, on occasion, epidemics have arisen which could, in part at all events, be traced to distinct causes (*e.g.* milk in 1879 and, though less distinctly and in less degree, shell-fish in 1899). Again, during certain periods, the distribution of the disease has altered in the sense that it has invaded areas usually free from fever, and spared other areas where formerly it was rife. Further, during recent years certain sanitary circumstances have changed, for instance, wells regarded with suspicion have been closed, a new sewerage system has been adopted and greater advantage has been taken of the public water supply. Considerations such as these have increased the difficulties of comparison between present and past enteric fever in Chichester, and of drawing general conclusions therefrom. But the broad fact nevertheless remains, that the continued prevalence in undue amount of enteric fever in Chichester, and its tendency to recur year after year in certain localities and to avoid or spare other areas of apparently similar character, are not to be satisfactorily explained by any of the agencies commonly associated with the cause of the disease. Dr. Thomson shows that neither foods (milk and shell-fish), water, sewerage nor rainfall (and subsoil water) can, either taken separately or even in conjunction, be regarded as agencies to be associated to any notable extent with the "continued recurrence of serious prevalence of enteric fever in Chichester." By a process of exclusion Dr. Thomson is driven to regard soil as the only remaining agency worthy of serious consideration, and in his judgment the hypothesis that the prevalence of enteric fever in Chichester is referable to soil conditions peculiarly favourable to the viability and the morbific power of the infective material of typhoid fever is not inconsistent with ascertained facts of previous pollution of the soil, or, to borrow still further from Dr. Thomson's cautious phraseology, with the "degree of potential pollution" of the soil of the place. Not indeed that he hazards this conjecture as wholly adequate to explain features that have characterised the fever in its distribution in time and place in Chichester; on the contrary, he calls for fuller knowledge (at present lacking) of soil conditions in their relations with fever prevalence, not only as regards Chichester, but also in connection with other localities similarly affected before definite conclusions of value can be drawn. In the above paragraphs an endeavour has been made to give the meaning of Dr. Thomson's conclusions, if not the exact form of his words. This has been done with the less scruple, since it appeared the only satisfactory way of introducing the subject matter of this report.

Briefly stated, this preliminary investigation was directed towards a comparative examination (chemically and bacteriologically) of the surface soils obtained respectively from certain "fever" and "non-fever" areas. Great care was exercised in the selection of the samples. Three visits were paid to Chichester and the ground carefully gone over, in company with Dr. Thomson and with the assistance of Mr. Saunders, the city surveyor, whose special local knowledge was of great value. Mr. Saunders's services at this stage and later during the course of the investigation were most cordially given, and are here gratefully acknowledged. As a result of these preliminary proceedings it was finally decided to submit to scrutiny samples of soil from certain fever and from non-fever areas which, in respect of class of house property, and as regards other local conditions, were fairly comparable. Altogether ten samples of soil were examined, five being taken from the back gardens of different houses situated in fever areas, and the remaining five from similar situations near to other houses which were not in districts habitually attacked by fever. Selection of particular spots for taking the samples of surface soil was a matter of some difficulty. On the one hand, mere bare trodden soil just outside a dwelling is liable to be materially altered, almost from hour to hour, by a variety of accidental circumstances to an extent which would necessarily mask the intrinsic differences, if there were any, between it and trodden soil similarly taken from just outside any other dwelling. On the other hand, caution was also needed in selecting untrodden soil of gardens at some little distance from dwellings. To use as samples recently manured soils from flower beds, for example, would obviously be to place other and important obstacles in the way of comparison. Upon the whole, therefore, it seemed to me best to collect samples of untrodden surface garden soil which at one or another time had been cultivated, but which now were free, or nearly so, from any growth of plants, and which had not been manured for a considerable time. In each instance the samples were taken some few yards away from the back premises of houses. Generally speaking, in determining the soils to be examined the plan adopted was first to select a soil in connexion with a dwelling in a fever area where enteric fever had not only occurred but had recurred, either in the particular house or in its immediate neighbourhood, and then to select another soil for comparison from the environment of a house of a similar class, but in a locality where no cases of typhoid had occurred and which was not in a fever-stricken (present or past) district. It will be understood then that the soils from the fever and non-fever areas were, so far as could be ascertained, comparable in every respect save that the former were collected in the immediate entourage of dwellings for which enteric fever had displayed a special proclivity, and the latter were taken from the neighbourhood of houses where the disease had not occurred.

In the bacteriological investigations which are now to be recorded no attempt was made to search for the specific germ of typhoid fever in the soils obtained from the fever areas. The difficulty of detecting even B. coli in soils not *recently* polluted, not to mention the huge total number of bacteria in most soils (rarely less than one million per gramme), militated against this. Moreover, the well known obstacles to isolating the typhoid bacillus even from the stools of enteric fever patients sufficed to indicate that such a search would be labour in vain, unless perhaps under peculiar circumstances, and in conditions by no means pertaining in the present case.

Chemically, each sample of soil was tested in respect of the quantity of free ammonia and of organic nitrogen present; bacterially, in each instance, search was made for (*a*) B. coli; (*b*) spores of B. enteritidis sporogenes, and (*c*) streptococci. As to these bacterial tests:—

(*a*) B. coli is an intestinal bacterium, and is present in sewage in numbers usually exceeding 100,000 per cc. It is not present at all, or only in very small number, in pure waters, and it is absent (or comparatively so) from pure soils. Further, it seems to be absent, or present in insignificant proportion, in soils *not recently* polluted. The difficulty or impossibility of isolating B. coli from waters and soils *not lately* contaminated by organic matter of animal origin is remarkable, in contrast with the ease with which this microbe can be isolated from a minimal quantity of sewage. Yet it were wise to guard this statement with the further remark that B. coli may conceivably, in course of time and under peculiar conditions, become in soil so altered in its morphological and biological characters as to be no longer recognisable. Statements as to the ubiquity of B. coli seem to be founded less upon actual observation than upon assumption that because B. coli is present in enormous numbers in the excrement of animals and in sewage it must be present everywhere in nature since these matters have an almost universal distribution. Here let it be remembered, however, that we have as yet no grounds for assuming that non-sporing microbes, of which B. coli is one, can remain dormant, neither multiplying nor dying, for an indefinite period, and if we hesitate to assume such a stage of quiescence then we must allow that, for a non-sporing microbe to be maintained, the rate of its reproduction must continue to be at least as great as the rate of its decay. But for this to take place in the case of B. coli, outside the animal body, the conditions would need to be ideally propitious, a course of events not likely to occur other than accidentally, or very occasionally. Far more likely is it that with microbes of the nature of B. coli the rate of decay usually greatly exceeds the rate of reproduction until finally extinction occurs. On this view B. coli and its allied forms present in a soil some little time after that soil has been polluted, are not microbes which have been merely lying "dormant" in passive state since pollution occurred, but they are those which have up to then succeeded in maintaining themselves in unfavourable surroundings and against active competition of other micro-organisms. Such a view would be more in accordance with observed facts, and would not necessarily be inconsistent with belief that under rare, and not wholly understood, conditions B. coli may multiply in nature even when separated from its initial animal surroundings.

Certainly, so far as my experience goes, the presence in any number of B. coli in surface soil indicates *recent*, and therefore presumably specially dangerous, pollution. Unless, indeed, the amount of assimilable organic matter introduced concurrently with B. coli or subsequently added is so great as in an exceptional degree to foster and prolong its life.

(*b*) *Spores of B. enteritidis sporogenes.* The spores of this pathogenic anaerobe are present in raw sewage in numbers usually exceeding 100 per cc. In pure soils they are absent from as much as 10 mgrms. (or even more), and in impure soils there may be as many as 10,000 spores present per gramme. As regards pure waters they may be absent from as much as 500 cc. (or even more). Unfortunately, the fact of B. enteritidis being a *sporing anaerobe* weakens somewhat its usefulness as a test of *recent* contamination. For it can be comparatively seldom that this microbe finds the conditions so favourable as to lead it to assume a vegetative form of existence, and in the form of spores it (unlike B. coli) doubtless survives even under unfavourable conditions for an indefinite period of time.

The importance of this microbe lies not only in the fact that its cultures are apt to be extremely virulent to guinea-pigs, but also rests on evidence showing that it may be causally related to certain cases of acute diarrhœa in the human subject.*

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* See reports by Dr. Klein in Annual Reports of the Medical Officer of the Local Government Board for 1897–8 and 1898–9; also reports by Dr. F. W Andrewes in the same for 1896–7, and in "The Lancet," January 7, 1899.

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(*c.*) *Streptococci.*—Much that has been said under the heading of B. coli applies here, but with even greater force. Streptococci are present in normal stools, even in so minute an amount as ·001 grm. In sewage there are usually present at least 1,000 streptococci per cc. But in water and soil they appear to be absent even from comparatively large quantities of these substances, except in those cases where the water or soil has been *freshly* contaminated with matters of animal outcome. Further, streptococci, *as a class*, are pathogenic germs, and are, moreover, among the least resistant of all known microbes. So that their presence in a substance, be it soil or water, would seem to imply a *dangerously close* association of that substance with excremental matters. Against this it may be urged that some streptococci are not pathogenic; that others may be hardy germs, capable of persisting and of multiplying in nature and when separated from the animal body; and lastly, that some streptococci may grow and flourish in soil and in water which, in their immediate antecedents at all events, have had no relation to the evacuations of animals. I am not prepared to deny that there may be truth in these contentions. Nevertheless I have failed to find streptococci in a river water, above all source of pollution, and yet have isolated them from 1/10,000 cc. of the same river water below the points of entrance of sewer outfalls; I have obtained uniformly negative results with virgin soil, and positive results with so minute a quantity as 1 milligramme or less of soils *recently* polluted with sewage. Further, I have obtained uniformly negative results in the case of soils which were known to have been contaminated at one time, but which were also known not to have lately been polluted.

Searching in the first instance for bacterial evidence of contamination of the Chichester soil samples by organic matter of animal origin, reliance was placed first on search for streptococci; secondly, on the presence or absence of B. coli; and lastly, on the number of spores of B. enteritidis sporogenes. The first and second of these tests were likely to afford indication of *recent* contamination, the third to show whether pollution had taken place either recently or at any time in the past. Thus, in soils grossly, but not recently, polluted it might not be possible to find B. coli or streptococci, while these same soils still harboured in a living condition numerous spores of B. enteritidis sporogenes. Maybe in future it will be found possible with B. enteritidis sporogenes, to estimate the "age of the pollution" to some extent by the degree of its virulence in culture. No such estimate can, however, be made in our present state of knowledge.

The following is a summary of contents of the report which follows:

SECTION I.—Experimental work; under:—

Series I.—A. *Chemical results.* B. *Bacteriological results.* C. *Remarks.* Soils F$_1$ (fever area) and N.F$_1$ (non-fever area).

" II. " " Soils F$_2$ (fever area) and N.F$_2$ (non-fever area).

SERIES III.—A. *Chemical Results.* B. *Bacteriological results.* C. *Remarks.* Soils F_3 (fever area) and $N.F_3$ (non-fever area).
" IV. " " Soils F_4 (fever area) and $N.F_4$ (non-fever area).
" V. " " Soils F_5 (fever area) and $N.F_5$ (non-fever area).

SECTION II.—General and concluding remarks.
SECTION III.—Tables 1–4.

SECTION I.—EXPERIMENTAL WORK.

SERIES I.

On September 27, 1899, two samples of surface soil were collected, the one from a "fever area" (back garden, 8, Parchment Street), the other from a "non-fever area" (back garden, 37, Whyke Lane). They were submitted to chemical and bacteriological examination on the day following (September 28, 1899). For convenience of description these samples of soil and subsequent ones will be distinguished as F. (fever area) and N.F. (non-fever area).

A. *Chemical results* (*see* Table 1).—(1) As regards *free ammonia* the following results were obtained :—F. = 0·03 ; N.F. = 0·027 mgrms. of ammonia respectively per gramme of soil (parts per 1,000). (2) The *organic nitrogen* was determined by Kjeldahl's process. The results were as follows :—F. = 2·146 ; N.F. = 1·323 mgrms. of nitrogen per gramme of soil (parts per 1,000).

B. *Bacteriological results* (*see* Tables 2, 3, and 4).—Each sample of soil was diluted and thoroughly mixed with sterilised water to form 10 per cent. and 1 per cent. dilutions. The former was called A. dilution (10 grammes + 90 cc. water), and the latter B. dilution (1 gramme + 99 cc. water).

Neither with these nor with subsequent samples of soil was an estimation of the total number of bacteria made. In judging the past history of the soils in respect of pollution reliance was placed on the search for (*a*) B. coli ; (*b*) spores of B. enteritidis sporogenes ; and (*c*) streptococci.

(*a*) *B. coli* (*see* Table 2).—Surface phenol (0·05 per cent.) gelatine plates were made with 0·1 cc. of A. (·01 soil) and B. (·001 soil) dilutions.

On comparing the plates it was noted in each instance that the colonies were most numerous in F., less numerous in N.F.

As regards F., in the A. dilution plate there were present a number of liquefying and non-liquefying fluorescent colonies. In the B. dilution plate seven colonies of the *granular bacillus**

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* In a previous report (App. B, No. 2, p. 290, 1897–8) this *granular bacillus* was briefly described, and two micro-photographs were given, showing its microscopic characters and the appearance of a surface colony in gelatine when slightly magnified (Fig. 10, Plate VI., and Fig. 9, Plate V., respectively). Old cultures, on microscopic examination, show appearances as of spore formation, and such cultures resist heating to 80° C. Nevertheless, a satisfactory double-stained preparation has not been obtained. Although characteristic of soil in the sense that it is specially abundant, it is not peculiar to soil, being occasionally met with in cultures made from sewage and water.

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were noted, and other three colonies of which one resembled B. coli very closely, the remaining two sufficiently closely (at the particular stage of their growth when examined) to merit subculture. The first of these proved to be B. coli or a closely allied form, and the remaining two were found to have no kinship with this microbe. (Table 2, microbes 1, 2, 3 F.$_1$.)

As regards N.F., in the A. dilution plate one colony of B. fluorescens liquefaciens was noted, and three colonies which although bearing no very close likeness to B. coli were nevertheless the only colonies in any way resembling it. On further study in subculture, however, they were readily differentiated from B. coli. (Table 2, micro-organisms 1, 2, 3 N.F.$_1$.) In the B. dilution plate there were 17 colonies of *granular bacillus*, but no colonies in the least like B. coli.

(*b*) Spores of *B. enteritidis sporogenes* (*see* Table 3).—With both F. and N.F. soils sterile milk tubes were inoculated with 1 cc. A. dilution (·1 grm. soil), 1 cc. B. dilution (·01 grm. soil), and 0·1 cc. B. dilution (·001 grm. soil). After heating to 80° C. for 10 minutes the tubes were placed under anäerobic conditions, and incubated at 37° C. A positive result was obtained with all the cultures both of the F. and N.F. soils; at least 1,000 spores were present per gramme of each soil.

(*c*) *Streptococci* (*see* Table 4).—Surface agar cultures were made with 0·1 cc. A. (·01 grm. soil) and B. (·001 grm. soil) dilutions of F. and N.F. soils.

As regards F., in the B. dilution plate, there were no colonies resembling streptococci; in the A. dilution plate, a few minute colonies showed themselves which could not, without sub-culture, be stated *not* to be streptococci. These (five in number) were subcultured in broth and incubated at 37° C. In two of the tubes no growth occurred, and in the remaining three, although there was a bacterial growth, the microbes in question turned out to be minute bacilli on examination. (Table 4, colonies 1–5 F.$_1$.)

As regards N.F., in the B. dilution plate there were no colonies resembling streptococci; in the A. dilution plate some small colonies not unlike streptococci were noted. Accordingly, five subcultures were made in broth from this plate and incubated at 37° C. In one tube no growth occurred, in the remaining four tubes a growth did occur; but on studying these microbes further, two of them were finally classed as staphylococci* and two as bacilli, all simulating, however, to some extent, both in their morphological and biological characters, streptococci. (Table 4, colonies 1–5, N.F.$_1$.)

On comparing the F. and N.F. agar cultivations side by side, it was noted that the total number of colonies was greater in the former, but the characters of the colonies seemed to be very similar in the two sets of cultures.

C. *Remarks.*—Considered chemically, the N.F. soil contained 10 per cent. and 38 per cent. less of free ammonia and organic nitrogen respectively than the F. soil. As regards the bacteriological examination, it is to be noted that B. coli (or a closely allied form) was present (although in small number) in the F. soil and was not found in the N.F. soil. The spores of B. enteritidis sporogenes were present in ·1, ·01, and ·001 gramme of both soils. No streptococci* could be found in either soil, although in the case of N.F. soil, two staphylococci simulating streptococci were isolated. Both in the gelatine and agar cultures the colonies were most numerous in those made from the F. soil. Speaking in general terms, it cannot be said that there was any striking difference between the two soils, either from the chemical or bacteriological point of view. But perhaps, all things considered, the F. soil showed most signs of organic pollution.

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* Staphylococci (*as a class*) are as compared with streptococci (*as a class*) hardy germs, and so, although of importance, do not seem to yield such reliable evidence of *recent*, and therefore presumably specially dangerous pollution, as the more delicate streptococci.

SERIES II.

On October 31, 1899, two samples of soil were collected, the one from a "fever area" (back garden, Plough and Harrow Inn, 145, St. Pancras), the other from a "non-fever area" (back garden, New Inn, 33, Whyke Road). They were examined the day following (November 1), both chemically and bacteriologically. As in Series I., the two samples of soil will be referred to as F. (fever area) and N.F. (non-fever area).

A. *Chemical results* (*see* Table 1).—In this series ammonia was determined, not directly from samples of soil, but from "soil washings," prepared as follows:—In each case 100 grms. of soil were thoroughly mixed with 500 cc. distilled water. The mixture was allowed to settle for two hours, and then 50 cc. of the comparatively clear liquid near the surface were withdrawn and made up to 500 cc. with ammonia-free distilled water. The liquid thus obtained was used for the estimation of the amount of free and albuminoid ammonia present.

(1.) *Free ammonia.*—The results were as follows:—F.=0·08, N.F.=0·096, parts per 100,000 of "soil washing."

(2.) *Albuminoid ammonia.*—Here the results were F.=1·6, N.F.=1·28, parts per 100,000 of "soil washing."

B. *Bacteriological results.*—As in Series I., each sample of soil was diluted and thoroughly mixed with sterile water to form 10 per cent. (A.) and 1 per cent. (B.) dilutions.

(*a.*) *B. coli* (*see* Table 2).—Surface phenol (0·05 per cent.) gelatine plate cultures were in each instance made with 0·1 cc. of A (·01 grm. soil) and B (·001 grm. soil) dilutions. The colonies were more numerous in the F. than in the N.F. cultures. In the case of A dilution the plates both of F. and N.F. were nearly liquefied by the second day, owing to the presence of rapidly liquefying fluorescent colonies. In the more dilute plates (0·1 of B dilution, F. and N.F.) the majority of the colonies were those of the *granular*

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* It must be understood that the failure to isolate streptococci does not *necessarily* imply their absence. In those cases where no growth occurred on subculture in broth of the *minute* colonies in the agar plates, the microbes in question may have been streptococci which had already lost their vitality. Indeed, this supposition would be in accord with our knowledge of streptococci, which, *as a class*, are undeniably very delicate germs.

bacillus; no colonies were found bearing any close resemblance to B. coli. Nevertheless, three colonies were selected from each plate which, among all the other growths present, seemed to be most like this microbe. These were subcultured in gelatine, and "shake" cultures made. None of them, however, produced any "gas" in the medium with one exception (B dil. of F.), and this one eventually liquefied the gelatine. (Table 2, 1–3 $F._2$; 1–3 $N.F._2$.)

(*b.*) *Spores of B. enteritidis sporogenes* (*see* Table 3).—The same amounts were used as in Series I., and here also all the F. and N.F. cultures gave a positive result; at least 1,000 spores were present per gramme of each soil.

(*c.*) *Streptococci* (*see* Table 4).—The same amounts were used as in Series I. The 0·1 cc. of A dilution plate was too crowded, both in the case of F. and N.F., for accurate observation. In the more dilute plate (0·1 cc. of B dilution, F. and N.F.) four minute colonies were selected for subculture in broth (37° C.). In two of the tubes no growth occurred, and in the other two the growth was produced by bacilli, not by streptococci. This was the case both with the F. and N.F. cultures. (Table 4, 1–4 $F._2$; 1–4, $N.F._2$.)

C. *Remarks.*—From the chemical point of view it is to be noted that the F. soil washing samples contained 16 per cent. less of free ammonia than the corresponding N.F. samples. But as regards albuminoid ammonia the N.F. samples contained 20 per cent. less than the F. samples.

The bacteriological examination showed that B. coli was absent to the extent of the experiment from both soils, and that the spores of B. enteritidis sporogenes were present in so minute an amount as 1 milligramme of each soil. As regards streptococci, these could not be isolated from either of the two soils.

In Series I. no striking difference had been made out between the $F._1$ and $N.F._1$ soils; still less could any useful distinction be drawn between soils $F._2$ and $N.F._2$.

SERIES III.

On November 27, 1899, two samples of soil were collected, the one from a "fever area" (back garden, 27, Victoria Road), the other from a "non-fever area" (back garden, 1, Lyndhurst Road). They were examined on the following day (Nov. 28). As in the preceding series, the two samples of soil will be referred to as F. and N.F. respectively.

A. *Chemical results* (*see* Table 1).—The results obtained were as follows:—

(1.) *Free ammonia.*—F.=0·024; N.F.=0·018, mgrms. of ammonia respectively per gramme of soil (pts. per 1000).

(2.) *Organic nitrogen.*—F.=2·112; N.F.=2·606, mgrms. of nitrogen respectively per gramme of soil (pts. per 1,000).

B. *Bacteriological results.*—Each sample of soil was diluted and thoroughly mixed with sterilised water to form 10 per cent (A); 1 per cent. (B); ·1 per cent. (C); ·01 per cent (D); and ·001 per cent (E) dilutions.

(*a*.) *B. coli* (*see* Table 2).—Surface phenol (0·05 per cent.) gelatine plate cultures were made with 0·1 cc. of C and D dilutions (*i.e.* ·0001 and ·00001 gramme of soil). On comparing the plates it was noted that the colonies were more numerous in the N.F. than in the F. cultures. Further, that whereas the *granular* bacillus was very prominent in the F. cultures it was almost absent from the N.F. cultures, the predominant organism here being one of the varieties of B. fluorescens non-liquefaciens. As regards B. coli, although in none of the plates (F. or N.F.) were there any colonies quite typical of B. coli, still there were a number which could not with absolute certainty be discriminated therefrom. Twelve of these colonies were subcultured in gelatine and "shake" cultures made. Three such cultivations were made from each of the two F. plates (C and D dilutions) and a similar number from each of the N.F. plates (C and D dilutions). One colony from the F. plate (D dilution) and one from the N.F. plate (also from D dilution) produced "gas," but these were subsequently found to be slow liquefiers so their further study was abandoned. In none of the other "shake" cultures was there any gas formation. (Table 2, 1–6 $F._3$; 1–6 $N.F._3$.)

(*b*) *Spores of B. enteritidis sporogenes* (*see* Table 3).—Milk cultures were made in the usual way. These contained 1 cc. of C, D, and E dilutions of soils F. and N.F. Both as regards F. and N.F. a positive result was obtained with 1 cc. of C and D and a negative result with 1 cc. of E dilutions; at least 10,000 but less than 100,000 spores present per gramme of each soil.

(*c*.) *Streptococci* (*see* Table 4).—Surface agar cultures were made with 0·1 cc. of B and C dilutions of soils F. and N.F. The character of the colonies developing in both sets of cultures seemed to be very much alike, but the colonies were most numerous (in contrast to the gelatine cultivations) in the F. plates. In all, eight subcultures were made in broth (37° C.), two from the B plate and two from the C plate in regard of each soil. But a negative result was obtained in all cases, there being either no growth or the growth of a microbe which could not be classed as a streptococcus. (Table 4, 1–4 $F._3$; 1–4 $N.F_3$.) From the agar culture of B dilution of F. soil a cladothrix was isolated which differed from the ordinary bismarck-brown cladothrix of soil although it produced a similar colouration in nutrient media. This microbe produced in subculture a strong and characteristic smell exactly resembling the smell of moist earth on a warm day. It thus differed in this as well as in other respects from Cl. dichotoma whose cultures are inodorous. It was at first thought to belong to a species not hitherto described, but on studying the question further it was found that Rullmann had already recognised a new species of bacterium as the cause of the peculiar smell of soil and called it cladothrix odorifera. There can be little doubt then that the microbe in question was identical with (or closely allied to) Rullmann's cladothrix odorifera (*see* Fig.1, Plate XXXII).

(*d*.) *Thermophilic bacteria.*—(68° C.) It has been suggested that the presence or proportionate number of "thermophilic" bacteria, those withstanding incubation at 68° C., might be employed as a test of pollution. The suggestion is founded on the presence of

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these bacteria in excremental matters and in sewage and their absence from pure waters. So far as my own experience goes these microbes are present in abundance in sewage, and they are also present in grossly polluted waters. But in certain cases I have found them to be absent from waters which by other and more reliable and delicate biological tests showed distinct evidence of objectionable contamination, and waters moreover which were known to have been recently polluted. Further, they are usually present in soils in considerable numbers, and in soils, be it observed, which by other bacterial tests showed *no* evidence of *recent*, and therefore presumably specially dangerous contamination, and whose past history yielded no evidence of pollution other than remote. Neither in point of delicacy nor as affording retrospective knowledge of dangerous fouling can this test be regarded as wholly satisfactory. When it yields a positive result, the pollution may be either recent or remote. In either case, more reliable and delicate tests are available.

Three broth cultures, each containing 1 cc. of A, B, and C dilutions of soils F. and N.F., were made. They were incubated at 68° C. Growth occurred in all the tubes.

(*e.*) *Gas formation in gelatine "shake" cultures.*[*]—1 cc. of dilutions A, B, and C (soils F. and N.F.) was added to gelatine tubes and "shake" cultures made. In 24 hours gas was formed in both A and B cultures, and more in the N.F. than in the F. cultivations. In 48 hours gas also appeared in 1 cc. of C dilution culture, and more in N.F. than in F.

C. *Remarks.*—As regards free ammonia, the N.F. soil contained 25 per cent. less than the F. soil, but in respect of organic nitrogen the F. soil contained 18 per cent. less than the N.F. soil. From the bacteriological point of view the soils appeared to be very similar in character, although gas formation was more distinct in the N.F. than in the F. gelatine shake cultures.

SERIES IV.

On January 16, 1900, two samples of soil were collected, the one from a "fever area" (back garden, 31 Orchard Street), the other from a "non-fever area" (back garden, 6 York Road). They were examined the following day. The former soil will be referred to as F., and the latter as N.F.

A. *Chemical results* (*see* Table 1).—The results obtained were as follows:—

(1.) *Free ammonia.*—F. = 0·021; N.F. = 0·012 mgrms. of ammonia respectively per gramme of soil (parts per 1,000).

(2.) *Organic nitrogen.*—F. = 2·277; N.F. = 2·112 mgrms. of nitrogen respectively per gramme of soil (parts per 1,000).

B. *Bacteriological results.*—Each sample of soil was diluted and thoroughly mixed with sterile water to form 10 per cent. (A),

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[*] As regards the value of this test reference may be made to Addendum B. to App. B, No. 3, of this volume.

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1 per cent. (B), ·1 per cent. (C), ·01 per cent. (D), and ·001 per cent. (E) dilutions.

(*a.*) *B. coli* (*see* Table 2).—Surface phenol gelatine plate cultures were made with 0·1 cc. of C and D dilutions (*i.e.*, ·0001 and ·00001 gramme of each soil). In each case the D plate contained only a few colonies. The C plate (F. soil) contained more colonies than the C plate (N.F. soil). In none of the plates were any colonies quite characteristic of B. coli, with the exception of two in the C plate (F. soil). Nevertheless, both in the case of the N.F. and F. soils, three subcultures were made from the C dilution plate of colonies which appeared most nearly to resemble B. coli. The result was negative as regards the N.F. cultures, and positive in two out of the three F. cultivations. The *granular bacillus* was very prominent in both sets of cultures, but fluorescent colonies were most numerous in the F. plates. (Table 2, 1–3 F.$_4$.; 1–3 N.F.$_4$.)

(*b.*) *Spores of B. enteritidis sporogenes* (*see* Table 3).—Milk cultures were made in the usual way. These contained 1 cc. of B, C, D and E dilutions of F. and N.F. soils. As regards F., the results were as follows:— Positive with 1 cc. B, C and D; Negative with 1 cc. E (10,000, but not 100,000 spores present per gramme of soil). In the case of N.F., the following results were obtained:—Positive with 1 cc. B; Negative with 1 cc. C, D, E (100, but not 1,000 spores per gramme of soil).

(*c.*) *Streptococci* (*see* Table 4).—Surface agar cultures were made with 0·1 cc. of B and C dilutions. The colonies were most numerous in the F. cultures, but the characters of the colonies developing in the two sets of cultures (F. and N.F.) seemed to be very similar. Three subcultures from minute colonies were made in broth (37° C.) in each instance from the B dilution of soils F. and N.F. In the three tubes (N.F. soil) no growth occurred; in two tubes (F. soil) there was also no growth, but in the remaining tube (F. soil) a micro-organism developed which, on further study, proved to be a staphylococcus. (Table 4, 1–3 F.$_4$; 1–3 N.F.$_4$.)

(*d.*) *Gas formation in gelatine shake cultures.*—Gelatine tubes were inoculated with 1 cc. of C, D, and E dilutions of soils F. and N.F., and "shake" cultures made. No gas was formed in any of the cultivations.

C. *Remarks.*—As regards free ammonia, the N.F. soil contained 43 per cent. less, and in respect of organic nitrogen 7 per cent. less, than the F. soil. Bacteriologically, it is to be noted that the F. soil contained B. coli or closely allied form, whereas in N.F. it could not be found; further, the F. soil contained many more spores of B. enteritidis than the N.F. soil. Also, the colonies developing in the gelatine and agar cultures were most numerous in F. soil. In this instance no difficulty was experienced in concluding that of the two soils F. showed the most signs of contamination.

SERIES V.

On January 22, 1900, two samples of soil were collected, the one from a "fever area" (back garden, 16, Taver Street), and the other from a "non-fever area" (back garden 13, East Pallant). They were examined on the following day. The former soil will be referred to as F. and the latter as N.F.

A. *Chemical results* (*see* Table 1).—The results obtained were as follows:—

(1.) *Free ammonia.*—F.=0·015, N.F.=0·021 mgrms. of ammonia in 1 gramme of soil (parts per 1,000).

(2.) *Organic nitrogen.*—F.=1·454, N.F.=1·783 mgrms. of nitrogen respectively in 1 gramme of soil (parts per 1,000).

B. *Bacteriological results.*—Each sample of soil was diluted and thoroughly mixed with sterile water to form 10 p.c. (A); 1 p.c. (B); ·1 p.c. (C); ·01 p.c. (D); and ·001 p.c. (E) dilutions.

(*a.*) *B. coli* (*see* Table 2).—Surface phenol gelatine plate cultures were made with 0·1 cc. of C and D dilutions (*i.e.*, ·0001 and ·00001 grm. of soil). A great many colonies of the *granular bacillus* were noted in both sets of cultures, particularly in those made from F. soil. But the total number of colonies (of all sorts) was greatest in the N.F. cultures. Neither in the F. nor in the N.F. plates were there any colonies even remotely like B. coli, so no subcultures were made.

(*b.*) Spores of *B. enteritidis sporogenes* (*see* Table 3).—Milk cultures were made, containing in each instance 1 cc. of dilutions B, C, D, and E of soils F. and N.F. The result in the case of soil F. was positive as regards dilutions B, C, D, and negative as regards dilution E, (10,000, but not 100,000 spores present per gramme of soil). Soil N.F. on the other hand yielded a positive result with B and C dilutions, and a negative result with D and E (1,000, but not 10,000 spores per gramme of soil).

(*c.*) *Streptococci* (*see* Table 4).—Surface agar cultures were made with 0·1 cc. of B and C dilutions of soils F. and N.F. No colonies in any way resembling streptococci could be found, and so no subcultures were made.

(*d.*) *Gas formation in gelatine "shake" cultures.*—1 cc. of dilutions B, C, D, and E of soils F. and N.F. were severally added to gelatine tubes and "shake" cultures made. No gas was formed in any of the cultures.

C. *Remarks.*—Soil F. contained 28 and 17 per cent. less respectively of free ammonia and organic nitrogen than soil N.F. But F. soil contained more spores of B. enteritidis sporogenes than soil N.F. B. coli and streptococci could not be found in either. And in none of the gelatine "shake" cultures was there any production of gas. Chemically considered, N.F. soil appeared to be the worst, but from the bacteriological point of view and as regards B. enteritidis sporogenes, F. soil seemed to show most signs of pollution.

SECTION II.—GENERAL CONCLUSIONS.

The chief results obtained in the investigation have been collected together in tabular form (Tables 1, 2, 3, and 4) so as to

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allow of a general comparison being made of the character of the soils collected from the "fever" and "non-fever" areas.

As regards the chemical results, it will be seen by referring to Table 1 that on two occasions the F. soil contained less free ammonia than the N.F. soil: the figures being 0·08 F. as compared with 0·096 N.F. (Series II., "Soil Washings," pts. per 100,000), a difference of —16 per cent.; and 0·015 F. as compared with 0·021 N.F. (Series V., pts. per 1,000), a difference of —28 per cent. In the three other samples the N.F. soil contained less free ammonia than the F. soil: the figures being 0·027 N.F. as compared with 0·03 F. (Series I., pts. per 1,000), a difference of —10 per cent.; 0·018 N.F. as compared with 0·024 F. (Series III., pts. per 1,000), a difference of —25 per cent.; and 0·012 N.F. as compared with 0·021 F. (Series IV., pts. per 1,000), a difference of —43 per cent.

As regards organic nitrogen, the F. soil contained less than the N.F. soil on two occasions: the figures being 2·112 F. as compared with 2·606 N.F. (Series III., pts. per 1,000), a difference of —18 per cent.; and 1·454 F. as compared with 1·783 N.F. (Series V., pts. per 1,000), a difference of —17 per cent. In the three other samples the N.F. soil contained less than the F. soil: the figures being 1·323 N.F. as compared with 2·146 F. (Series I., pts. per 1,000), a difference of —38 per cent.; 1·28 N.F. as compared with 1·6 F. (Series II. Here the albuminoid ammonia per 100,000 in the "Soil Washings" was determined), a difference of —20 per cent.; and 2·112 N.F. as compared with 2·227 F. (Series IV., pts. per 1,000), a difference of —7 per cent.

While both the F. and N.F. soils may be said to have been rich in organic matter, it cannot be asserted that the difference between the soils obtained respectively from the fever and non-fever areas was either significant or constant, although on the whole the former showed, in regard to the tests employed, a somewhat higher proportion of organic matter probably resulting from pollution of animal origin.

Passing next to the bacteriological results, it will be seen from Table 2 that none of the N.F. soils contained B. coli or closely allied forms. Soils F.$_1$ (Series I.) and F.$_4$ (Series IV.) on the contrary contained this microbe or very closely allied forms.

No streptococci* (Table 4), could be found in any of the F. and N.F. soils. Staphylococci, however, were present in soils N.F.$_1$ (Series I.), and F.$_4$ (Series IV.). It must be remembered that in those cases where the subcultures in broth of the minute colonies occurring in the agar plates failed to show any growth the microbes may in reality have been streptococci which had already lost their vitality.

The results of the examination of the soils for the spores of B. enteritidis sporogenes are given in Table 3.

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* As a contrast to these negative results, it would not be amiss to consult App. B, No. 4, in this volume. In that report it is shown that streptococci are frequently present in the "washings" of certain soils recently polluted with matters of animal outcome.

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It will be seen that $F._1$, $N.F._1$, $F._2$, and $N.F._2$ soils contained at least 1,000 spores of B. enteritidis sporogenes per gramme; soils $F._3$ and $N.F_3$ at least, 10,000 but not 100,000; soils $F._4$ and $F._5$ at least 10,000 but not 100,000, as compared with 100 but not 1,000 in soil $N.F._4$, and 1,000 but not 10,000 in soil $N.F._5$.

Generally speaking, the total number of colonies in the gelatine and agar plates was greater in the F. than in the N.F. cultures; but as a rule the appearance of the colonies in the two sets of cultivations was very similar.

Regarding B. enteritidis sporogenes as evidence of previous, but not necessarily recent, contamination with organic matter of animal origin, all the soils showed signs of having been thus polluted at one time or another. Soils $F._4$ and $F._5$, it will be observed, contained ten times as many spores as soils $N.F._4$ and $N.F._5$ (Table 3).

Taking the view that B. coli affords evidence of *recent* contamination, it is to be noted that, after very careful investigation, B. coli was not detected in any of the cultures of the N.F. soils, but that in soil $F._1$ and $F._4$ this microbe was found. It may, therefore, be said that by this test none of the soils showed signs of *recent* pollution, with the exception of two ($F._1$ and $F._4$) of the soils collected from fever areas (Table 2).

Lastly, hazarding the opinion that the presence of streptococci points strongly to pollution of animal origin at a *quite recent date*, it is noteworthy that in none of the soils could these microbes be found. So that it is permissible to conjecture that none of the soils had *quite lately* been contaminated with matters of animal outcome (Table 4).

Notwithstanding the foregoing account of chemical and bacterial differences between the several soils examined, it appears to me doubtful whether any of them, F. or N.F., can be regarded as differing in respect of pollution markedly from soils in the immediate environment of dwellings in other localities, occupied by dwellings of a similar class, elsewhere than at Chichester.

And when the F. and N.F. soils (obtained respectively from the "fever" and "non-fever" areas) are contrasted, both from the chemical point of view and biologically, it seems clear that the F. soils upon the whole showed evidence of somewhat greater pollution, but that the points of difference, although worthy of note, were not of signal importance, and moreover they were not constant throughout the series of five comparative determinations. But, of course, it must not be argued from this that soil plays no *rôle* in fostering and localising typhoid fever in Chichester. All that can be said is that the tests employed failed to indicate any constant or striking dissimilarity between the particular samples of surface soil obtained from the fever and non-fever areas. Possibly different results might have been obtained if the deeper layers of soil had been examined, and again a prolonged investigation of the quality of the subsoil waters in the fever and non-fever areas might yield valuable results.

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As regards the deeper layers of soil, it is known that the number of bacteria in soils diminishes rapidly with each foot of descent after the first few feet. It is perhaps not out of place to give in tabular form the chief results which I obtained in 1893* when working at this subject with soil in the grounds of Morningside Asylum, Edinburgh. The samples were obtained from a plot of land formerly a vegetable garden, but which at the date of experiment had lain untouched, even at the surface, for a considerable time :—

Number of Aërobic Bacteria in the Soil at different Depths.

Level.	Number of Experiments.	Number of Samples of Soil.	Moisture in Soil.	Average Number of Germs in 1 Gramme of Soil.
Surface	14	5	17·9 °/ₒ	1,687,799
1 foot	12	4	16·7 „	1,103,589
2 feet	19	5	10·4 „	902,944
3 feet	25	5	8·2 „	173,807
4 feet	19	5	9·2 „	25,130
5 feet	15	3	7·6 „	922
6 feet	18	5	5·5 „	410

It will be noted that below 2 feet in depth the number of microbes diminished rapidly, and 6 feet from the surface the number of bacteria per gramme of soil was only 410, as compared with over 1½ million at the surface respectively. But it does not follow that because the total number of micro-organisms shows a decrease each particular species diminishes in a like ratio; on the contrary, it is conceivable that some species of germs may not only maintain their existence but actually increase in number in the deeper layers of soil. All this is said not without motive. In the experimental surface soils of Chichester streptococci could not be found, and even B. coli was only rarely found, but whether or not these microbes existed in the deeper

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* Ed. Med. J., June, 1893.

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layers of the soil cannot be said. It is conceivable that B. coli and streptococci (not to speak of other germs) accidentally sown on a soil might rapidly perish at the surface owing to the unfavourable conditions (sunshine, extremes of heat and cold, lack of humidity, &c.) prevailing there, and yet maintain their vitality in the deeper layers for a considerable period.

It will naturally be asked do the results of these Chichester experiments, limited though they be to small samples taken from comparatively few localities, nevertheless afford ground for supposing that the typhoid bacillus is likely to perish in surface soil in general and in that of Chichester in particular?

In attempting to answer this question, it is to be borne in mind that, so far as we know, B. coli is always likely to be associated with the typhoid bacillus, and is usually present in far greater abundance than B. typhosus. It is true that in the urine of typhoid patients the bacillus of enteric fever is sometimes present, not only in great numbers but also, it may be, almost in pure culture. Nevertheless it may safely be assumed that in nearly all cases of pollution of water or soil with the infective material of typhoid fever B. coli is likely to be initially present in far greater number than Bacillus typhosus. Now, under all conditions of laboratory experiment B. coli shows itself to be a much more hardy germ than B. typhosus; thus it not only grows much more rapidly but multiplies in media in which the more particular typhoid bacillus can barely, if at all, maintain its existence; again, it survives under unfavourable physical conditions which would speedily prove fatal to the more delicate germ of enteric fever. So that there is some justification for assuming that the failure of B. coli to maintain itself in nature, *e.g.*, in soil, implies somewhat strongly that B. typhosus would also perish in comparable circumstances. It has been shown that in the amounts used B. coli was absent from all the non-fever soils and present only in two of the fever soils. Hence it is permissible to infer that the conditions were so unfavourable as to lead to the death of this microbe, for that it at one time gained access to the several surface soils examined may be considered highly probable in view of the large number of spores of B. enteritidis sporogenes present in each instance. And if the conditions were so unfavourable as to render all the soils in general unsuitable for the existence of B. coli, it is unlikely that B. typhosus could have maintained its vitality in any of them. In any case, as regards the particular "fever" soils, the comparative absence of B. coli, whether arising from absence of previous pollution, which seems unlikely, or from decay and death of the species, which appears more probable, implies that, as a matter of fact, the typhoid bacillus was almost certainly absent from the samples examined. There is another reason for believing that a non-sporing microbe like B. typhosus would speedily perish in surface soil. As a result of a very large number of experiments I have drawn attention, not only to the large actual number of bacteria present in spore-form in surface soil, but also to their number relative to the total number of microbes present. Thus, in App. B, No. 2, 1897–8 (as well as in later reports), it has been shown that in soil the actual

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number of spores is commonly from ten to a hundred thousand or more per gramme, and that the ratio of spores to the total number of bacteria is rarely less than 1 in 10. In sewage, the number of spores per cc. is usually 200–300, and the ratio of total spores to total bacteria one to ten thousand or more. In my judgment, the reason why spores are present in such abundance in surface soil is because the conditions are frequently so unfavourable that only those species of bacteria which can form spores can maintain their existence for any length of time.

In conclusion, it may be stated that this investigation was undertaken as a preliminary to determining the viability of the typhoid bacillus in Chichester soil *in sitû*, when added artificially thereto in gross amount; always provided that the comparative examinations of the soils obtained respectively from the fever and non-fever areas clearly indicated that such a research would be likely to yield results of special value. But the results of the preliminary investigation do not point to the fever area soils being widely different in bacterial composition from the soils obtained from the non-fever areas. Therefore, there would seem to be no very special indication for carrying out so laborious a piece of work so far afield, and it is open to question if the subject might not be attacked with greater advantage in an indirect manner, and not necessarily at Chichester. I may here observe that if there is any truth in what has been said about the companionship of B. coli and B. typhosus, the preponderance of the former microbe, and its more hardy character; further, if it be true that B. coli is not ubiquitous in soil, but, on the contrary, is absent or present only in small number in the case of soils free from recent pollution, useful results might very well be obtained by inoculating soil with B. coli instead of B. typhosus, and observing the ultimate fate of this micro-organism. In this connection the comparative ease and certainty of detecting B. coli in a mixed bacterial flora as contrasted with the almost insuperable difficulties attending the isolation of B. typhosus is well worthy of consideration. One way in which this research could be carried out at once suggests itself. Sewage is known to be an important factor in disseminating typhoid fever. As regards the number of B. coli in crude sewage, it may be said with some confidence, as the result of very numerous experiments, that its numbers usually exceed 100,000 per cc. It would only be necessary then to have a portion of a sewage farm placed at one's disposal. The soil could first be examined during its "treatment" with sewage in the ordinary way, *i.e.*, while it was being saturated with sewage germs. Then the application of the sewage might be discontinued and the ultimate fate of B. coli (and incidentally, perhaps, the spores of B. enteritidis sporogenes) in the soil determined from time to time. Such a research might be expected to yield useful results from the epidemiological point of view.

SECTION III.—TABLES.

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Table 1.

Showing the results of the chemical examination of soils F. and N.F. obtained respectively from the "fever" and "non-fever" areas.

Description.	Free Ammonia.		Organic Nitrogen.	
	F.	N.F.	F.	N.F.
Series I. .. .. (pts. per 1,000.)	0·03	0·027 (– 10 p.c.)	2·146	1·323 (– 38 p.c.)
Series II. .. .. ("Soil washings," pts. per 100,000.)	0·08 (– 16 p.c.)	0·096	1·6 alb. amm.	1·28 alb. amm. (– 20 p.c.)
Series III. .. .. (pts. per 1,000.)	0·024	0·018 (– 25 p.c.)	2·112 (– 18 p.c.)	2·606
Series IV. .. .. (pts. per 1,000.)	0·021	0·012 (– 43 p.c.)	2·227	2·112 (– 7 p.c.)
Series V. .. .. (pts. per 1,000.)	0·015 (– 28 p.c.)	0·021	1·454 (– 17 p.c.)	1,783

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TABLE 2.

SHOWING the RESULT of the SUB-CULTURES of the COLONIES of SOILS F. (fever area)

The colonies chosen for sub-culture were either (1) indis sufficiently to merit further study, or (3) among all the other approximate to the coli type.

Sub-cultures of Colonies from Surface Phenol (0·05 %) Gelatine Plate Cultures.	SERIES I.						SERIES II.					
	F.$_1$.			N.F.$_1$.			F.$_2$.			N.F.$_2$.		
	Microbe.			Microbe.			Microbe.			Microbe.		
	1.	2.	3.	1.	2.	3.	1.	2.	3.	1.	2.	3.
Gas formation in gelatine "shake" cultures in 24 hrs. at 20° C.	+	- *	Same as microbe 2, F.$_1$.	-	Same as microbe 1 N.F.$_1$.		+	-	-	-	-	-
Broth cultures at 37° C. (a) diffuse cloudiness in 24 hrs. (b) indol 5 days.	(a) + (b) -	(a) ? (b) +		(a) ? (b) +			Microbe 1 finally liquefied the gelatine, and microbes 2 and 3 gave no gas. They were not studied further.			As microbes 1, 2, and 3 gave no gas in gelatine "shake" cultures they were not studied further.		
Litmus milk cultures at 37° C. (a) acidity (b) clot.	(a) + (b) -	No visible change in 48 hrs.		No visible change in 48 hrs.								
REMARKS ..	B. Coli or closely allied form.	* Finally liquefied gelatine.	Microbes 2 and 3 F.$_1$ no kinship to B. Coli.	Microbes 1, 2, 3, F.$_1$ no kinship to B. Coli.			Microbes 1, 2, 3, F.$_2$ no kinship to B. Coli.			Microbes 1, 2, 3, N.F.$_2$ no kinship to B. Coli.		

TABLE 2.

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taken from the SURFACE PHENOL GELATINE PLATE CULTURES and N.F. (non-fever area).

tinguishable from B. coli, or (2) resembled this microbe colonies present were the ones which seemed most closely to

SERIES III.												SERIES IV.						SERIES V.
F.$_3$.						N.F.$_3$.						F.$_4$.			N.F.$_4$.			Soils F.$_5$ and N.F.$_5$.
Microbe.						Microbe.						Microbe.			Microbe.			
1.	2.	3.	4.	5.	6.	1.	2.	3.	4.	5.	6.	1.	2.	3.	1.	2.	3.	
+	-	-	-	-	-	+	-	-	-	-	-	+	-	+	-	-	-	No colonies even remotely like B. Coli in phenol gelatine plate cultures of soils F.$_5$ and N.F.$_5$, so no sub-cultures were made.
Microbe 1 finally liquefied the gelatine, and microbes 2, 3, 4, 5, and 6 gave no gas in gelatine "shake" cultures so they were not studied further.						Microbe 1 finally liquefied the gelatine, and microbes 2, 3, 4, 5, and 6 gave no gas in gelatine "shake" cultures so they were not studied further.									Finally liquefied the gelatine.			
												(a) + (b) -	(a) - (b) -	(a) + (b) -	The growth was not characteristic either in 1, 2, or 3.			
												(a) + (b) -	(a) - (b) -	(a) + (b) -	The growth was not characteristic either in 1, 2, or 3.			
Microbes 1, 2, 3, 4, 5, and 6, F.$_3$ no kinship to B. Coli.						Microbes 1, 2, 3, 4, 5, and 6, N.F.$_3$ no kinship to B. Coli.						B. Coli or closely allied form.	No kinship to B. Coli.	B. Coli or closely allied form.	Microbes 1, 2, 3, N.F.$_4$ no kinship to B. Coli.			

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Table 3.

Showing the number of spores of B. Enteritidis Sporogenes (Klein) in 1 gramme of soils F. ("fever" area) and N.F. ("non-fever" area).

Series.	F. Soils.						N.F. Soils.					
	1 cc. of dilutions A, B, C, D, E. Gramme					Number of Spores of B. Enteritidis Sporogenes in 1 grm.	1 cc. of dilutions A, B, C, D, E. Gramme					Number of Spores of B. Enteritidis Sporogenes in 1 grm.
	·1	·01	·001	·0001	·00001		·1	·01	·001	·0001	·00001	
I.	+	+	+			At least 1,000	+	+	+			At least 1,000
II.	+	+	+			„ „	+	+	+			„ „
III.			+	+	-	10,000, but not 100,000.			+	+	-	10,000, but not 100,000.
IV.		+	+	+	-	„ „		+	-	-	-	100, but not 1,000.
V.		+	+	+	-	„ „		+	+	-	-	1,000, but not 10,000.

TABLE 4.

TABLE 4.

SHOWING the RESULTS of SUB-CULTURING MINUTE COLONIE of SOIL F. (fever area

[The colonies chosen for sub-culture were too small to allow of satisfactor nature, sub-cultures were accordingly made. The selected colonies wer merit sub-culture, or (3) among all the other colonies present seemed mos

Sub-culture of Minute Colonies from Surface Agar Cultures. 37° C.	SERIES I. F.1. Minute Colony. 1.	2.	3.	4.	5.	N.F.1. Minute Colony. 1.	2.	3.	4.	5.
Morphology.	No growth occurred in broth cultures.*		Growth occurred in broth culture, but on microscopic examination the microbes were found to be bacilli.			No growth occurred in broth cultures.	Stains well by Gram's method. Cocci, in size and arrangement, resemble a staphylococcus.	Stains well by Gram's method. Very small cocci in short chains and masses.	Stains by Gram's method. A minute bacillus forming chains.	Stains by Gram's method. Cells very irregular in shape, occurring singly, in chains, and clusters. Classed finally as bacillus.
Broth cultures, 37° C.							Clear broth, at sides and foot of tube white veil-like growth.	Slight granular cloudiness, at foot of tube not very abundant granular white deposit.	Slight granular cloudiness, and granular deposit at foot of tube.	Very slight granular cloudiness and granular white deposit at foot of tube.
Gelatine "streak" cultures, 20° C.							Growth more like staphylococcus than streptococcus. Eventually tinge of yellow and slow liquefaction.	Growth, at first like a streptococcus, later, more like a staphylococcus. No liquefaction.	Small transparent colonies like a streptococcus. No liquefaction, but by fifth day, pale citron colour.	Colonies of small size but fairly opaque. No liquefaction, but by fifth day, pale yellow colour.
Agar "streak" cultures, 37° C.							In appearance, growth stood midway between a staphylococcus and a streptococcus.	White growth, at first like a streptococcus, later, more like a staphylococcus.	Small transparent colonies like a streptococcus. By fifth day, pale citron colour.	A feeble growth in 24 hours, later, more luxuriant and eventually of pale yellow colour.
Litmus milk cultures, 37° C.							No visible change in four days.	No visible change in four days.	No visible change in four days.	No visible change in four days.
Remarks.							Finally classed as a staphylococcus.	Finally classed as a staphylococcus simulating a streptococcus.	A chromogenic bacillus, simulating a streptococcus.	Finally classed as a chromogenic bacillus.

* It is to be noted that in those cases where no growth occurred in the broth cultures it does no contrary, may have been streptococci which had already lost their vitality and so could not be transplanted streptococci.

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Report on the Chemical and Bacteriological Examination of Samples of Soil; by Dr. Houston.

TABLE 4.

taken from the SURFACE AGAR PLATE CULTURES (at 37° C.) and N.F. (non-fever area).

microscopic preparation being made of them directly. To ascertain their either (1) like streptococci, or (2) resembled them sufficiently closely to nearly to approximate to the streptococcus type.

SERIES II.								SERIES III.								SERIES IV.						SERIES V.
F.$_2$.				N.F.$_2$.				F.$_3$.				N.F.$_3$.				F.$_4$.			N.F.$_4$.			
Minute Colony.				Minute Colony.				Minute Colony.				Minute Colony.				Minute Colony.			Minute Colony.			Soil, F.$_5$ and N.F.$_5$.
1.	2.	3.	4.	1.	2.	3.	4.	1.	2.	3.	4.	1.	2.	3.	4.	1.	2.	3.	1.	2.	3.	
No growth occurred in broth cultures.		Growth occurred in broth cultures, but, on microscopic examination, the microbes were found to be bacilli.		No growth occurred in broth cultures.		Growth occurred in broth cultures, but, on microscopic examination, the microbes were found to be bacilli.		The result was negative. Either no growth occurred in broth tubes or the growth was not produced by a streptococcus.				The result was negative. Either no growth occurred in broth tubes or the growth was not produced by a streptococcus.				No growth occurred in broth cultures.		Stains well by Gram's method. Cocci, in size and arrangement, resemble a staphylococcus. Diffuse cloudiness. Colonies of fair size and opaque. At first growth, white, later of yellow colour. Finally, liquefied gelatine. Growth too opaque and luxuriant for a streptococcus. At first white, but later of citron-yellow colour. No change in three days at 37° C. Finally classed as a staphylococcus.	No growth occurred in broth cultures.			No minute streptococcus—like colonies in surface agar plate cultures of soils F.$_5$ and N.F.$_5$ so no sub-cultures were made.

necessarily follow that the colonies in the plate cultures were not streptococci. Some of them, on th into fresh media. This view will probably be endorsed by those who have experience of working with

No. 7.

App. B, No. 7.

On Cockles as Agents of Infectious Disease: by Dr. Klein, F.R.S.

PRELIMINARY REPORT on COCKLES as AGENTS of INFECTIOUS DISEASE; by DR. E. KLEIN, F.R.S.

In view of the increasing number of instances in which groups of cases of typhoid fever are being referred to the consumption of raw cockles, especially to cockles gathered from foreshores notoriously polluted by sewage, it was determined to ascertain :—

(1.) Whether cockles from parts of the seashore which are obviously polluted by sewage contain within their interior the living microbes of sewage; and

(2.) What is the behaviour of the typhoid bacillus within the bodies of cockles if these shellfish be kept in water experimentally polluted with the material of typhoid fever.

So far, I have only been able to deal, except tentatively, with the first of these questions, and my proceedings in this respect have been as follows :—

Series A.—Through the Medical Officer of the Board I received two samples of cockles on November 13th, 1899.

Sample 1 was from a foreshore, 1,800 yards from high water mark and 1,500 yards from a sewer outfall.

Sample 2 was from the same foreshore, 80 yards from high water mark, and 500 yards from the sewer outfall.

Experiments undertaken with the samples on November 13th were these :—

From each sample, four cockles, each of which was apparently in healthy condition and had its shell tightly closed, were put under the tap, and the outsides of their shells were well brushed with a clean brush; subsequently each of them was well dried with a new and clean cloth. Next, the shell of each cockle was forced open by means of a sterilised chisel, and the body of the cockle was cut into small bits with sterilised scissors. Of the emulsion thus made, two or three drops, taken up in a freshly drawn out capillary pipette, were transferred to the following media :—

(*a*.) Phenol broth.

(*b*.) The surface of phenol gelatine.

As a result :—

(*a*.) The eight phenol-broth cultures were all found turbid after 24 hours' incubation at 37° C. From them, therefore, with a platinum loop, sub-cultures were in each instance made in shake gelatine and in litmus milk. Colonies that in the course of incubation produced gas bubbles in the gelatine without liquefying the medium, and which turned the litmus milk red and curdled it, would be probably those of typical bacillus coli; whereas colonies that in the shake gelatine did not produce gas bubbles and did not liquefy the medium, and which turned the litmus milk red without curdling, would deserve to be further tested as to whether they were varieties of bacillus coli or were typhoid bacillus.

As matter of fact, all the shake gelatine cultures contained colonies which did not produce gas, but liquefied the medium. They were not, therefore, typical b. coli nor varieties of that microbe; nor were they the typhoid bacillus. As to the litmus milk cultures, which all remained fluid, some became red, while others retained their blue colour. These latter could be at once discarded as not being bacillus coli (typical or otherwise), since all varieties of bacillus coli form acid. The litmus milk cultures that turned red (acid formation) were, notwithstanding that they remained fluid, used for further sub-cultures on surface phenol-gelatine plates. No colonies of bacillus coli or of typhoid bacillus were, however, obtained in these plates.

(*b.*) The eight phenol-gelatine surface plates inoculated with the several cockle emulsions were, after incubation for two to three days at 20° C., carefully submitted to scrutiny. Those colonies that were liquefying the medium were not further considered, not being bacillus coli or typhoid bacillus. Those, however, that presented a translucent flat aspect, with crenate or irregular outline, were further examined under the microscope, and were also used for sub-cultures in broth, in shake gelatine, and in litmus milk.

The outcome of examination of these eight original phenol-gelatine surface plates was that only one (corresponding to cockle No. 6) afforded several colonies which in aspect might have been those of bacillus coli or of the typhoid bacillus; in the other seven plates only liquefying colonies were present.

From the plate in question (cockle No. 6) six of the suspected colonies were sub-cultured in gelatine shake, in broth, and in litmus milk. Not one, however, formed gas; five of the six liquefied gelatine after several days' growth; one only proved a non-liquefying microbe. This particular microbe on further examination was found to form chains of very short bacilli with polar staining, almost like diplococci; it was non-motile, and did not redden litmus milk. It was, therefore, neither bacillus coli nor the typhoid bacillus.

Series B.—A second batch of cockles was received on February 7th from same locality as the first series. These were experimented with in an exactly similar manner, viz., the bodies of eight cockles were made into separate emulsions, each of which was tested culturally for the detection of bacillus coli or its varieties, as also for detection of the typhoid bacillus. In addition anaërobic milk cultures were set up in each instance in order to detect bacillus enteritidis sporogenes.

The result of Series B may be briefly summed up :—

(1.) No definite typhoid bacillus colonies were discovered. In one phenol-gelatine plate only did there appear a colony which might be typhoid bacillus. This colony comprised very motile cylindrical bacilli, closely resembling in these respects and in size the typhoid bacillus. Sub-cultures were accordingly made in shake and streak gelatine, in broth, and in litmus milk. As a result, the microbe in response to these tests also behaved like the typhoid bacillus; that is to say, it did not liquefy the gelatine, while in aspect and in growth, in not producing gas in gelatine, in not curdling but in reddening litmus milk, and in not producing indol in broth after four to five days at 37° C., it presented the characters of the typhoid bacillus. But on subjecting this microbe to test with typhoid blood serum, it failed to undergo any clumping or agglutination; so that I do not feel justified in considering it the bacillus of typhoid fever.

(2.) Typical bacillus coli was detected in three out of the eight cockles.

(3.) Typical virulent bacillus enteritidis sporogenes was detected in four out of the eight cockles.

From this it appears that the interior of some of these cockles did, as matter of fact, contain microbes of sewage.

Series C.—From a street hawker, a dozen raw cockles (in their shells) were bought, and eight of them were each subjected to the several bacterioscopic analyses adopted in the previous series. The result was that :—

(1.) No typhoid bacillus was found;

(2.) Bacillus coli (typical) was found in five out of the eight cockles;

(3.) Virulent bacillus enteritidis sporogenes was found in four out of the eight cockles.

No. 8.

On the BEHAVIOUR of CERTAIN PATHOGENIC MICROBES in MILK, CREAM, and CHEESE; by DR. E. KLEIN, F.R.S.

APP. B. No. 8.

On the Behaviour of Certain Pathogenic Microbes in Milk, Cream, and Cheese; by Dr. Klein, F.R.S.

It is a well established fact that cow's milk has on occasion served as a vehicle of infection of tuberculosis, of enteric fever, of scarlatina, and of diphtheria.

The questions to which I have directed my attention in the inquiry with which I now deal have been :—

(1.) Is ordinary cow's milk, sterilized for the purpose of experiment, capable of serving as a culture medium in which any or all of the following pathogenic microbes can multiply and thrive—bacillus tuberculosis, bacillus typhosus, streptococcus scarlatinæ, and bacillus diphtheriæ?

(2.) If so, what conditions in each instance may be regarded as favourable to their multiplication in milk?

(3.) What modifications in biological character and in pathogenicity, if any, are produced in the case of each of these microbes as a result of culture in milk?

(4.) What is the answer to corresponding questions when cream and cheese, after sterilization, are substituted for cow's milk as experimental culture media for the micro-organisms in question?

The following is an account of work which I have this year undertaken in reference to these questions.

BACILLUS TUBERCULOSIS.

For some years after 1882, the date of Koch's discovery of the tubercle bacillus, much difficulty was met with in growing the bacillus in artificial media, even upon one so apparently favourable as solidified blood serum. Seemingly at this early period no attempt was made to cultivate it in milk, nor can I find reference to experiments on its cultivation in milk in more recent times. The reason of this is doubtless that, after Nocard and Roux succeeded in showing that the bacillus grows luxuriantly on glycerinated agar and in glycerinated broth, these convenient media have been almost exclusively employed in the cultivation of bacillus tuberculosis in the laboratory.

Before describing my experiments with milk it will be well to recall some facts as to the virulence of tubercle bacilli when grown under laboratory conditions. Many observers have shown that cultures of tubercle bacillus in glycerinated agar, when carried on from generation to generation, lose gradually and largely their initial virulence. In course of time they fail on inoculation into the guinea-pig to produce typical "inoculation tuberculosis," such as is readily produced by a similar inoculation of this animal with material directly taken from tubercles of man or other animal. On the contrary, a glycerine agar culture removed by many transferences from the original source (man or animal), although showing copious and typical growth of true "acid-fast"* tubercle bacilli, will commonly produce on inoculation into the groin of the guinea-pig merely a local abscess, leading to an open sore, from which the animal completely recovers; or, if the culture inoculated is separated by a still larger number of removes from its original source its inoculation may not produce any local result at all.

In my own laboratory, for example, I have carried on from sub-culture to sub-culture on glycerine agar the same stock of tubercle bacilli for over ten years. The cultures now are so devoid of virulence that not even one-third to one-half a culture (the whole slanting surface of the agar being covered with continuous growth in the shape of a folded crinkled membrane) is on subcutaneous inoculation into the groin or peritoneum capable of producing abscesses or any other effect whatever. Yet the character of the growth, and the "acid-fast" character of the bacilli, are undoubtedly those of true tubercle bacilli. On the other hand, it is common knowledge that this attenuation of virulence does not take place to anything like the same extent when a series of subcultures is maintained on the surface of solidified blood serum. Moreover, there is no difficulty in showing that, when growth on a glycerinated agar culture that had lost all virulence is transferred to a serum tube, the resulting growth on the serum distinctly regains some degree of pathogenicity. After two or three further sub-cultures on blood serum have been made in succession (occasionally after only one sub-culture on this medium) decided virulence will be regained, so that moderately large doses will on subcutaneous or intraperitoneal inoculation produce disseminated tubercles containing typical tubercle bacilli, and will eventually lead to the death of the animal.

Growth of Tubercle Bacilli in Milk.

From glycerine agar cultures, which, as stated just now, had been maintained by sub-cultures for over ten years, I inoculated test tubes containing ordinary milk which had been sterilised. The test tubes were capped with guttapercha paper, and kept in the incubator at 37° C.

In all cases the milk remained fluid; there was no trace of curdling. The cream layer remained unchanged for several weeks, but after two months and more gave way to a yellowish layer of oil. Withdrawing a little milk from the bottom of the tube from time to time by means of a sterile capillary glass pipette, and examining for tubercle bacilli, I found that already after a week, and more distinctly after 10 or 12 days, there were present numerous small and large clumps made up of "acid-fast" tubercle bacilli. That these clumps consist of bacilli in active growth is shown by the fact that some are exactly like the branching strands and festoons, which are seen in the case of an actively growing culture on blood serum (Figs. 46, 47, and

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* *See* Addendum to this Report.

48, Plate XVIII.). The bacilli composing these strands and their branches were shorter or longer cylindrical bacilli, showing segregation of their protoplasm.

The same comparatively rapid multiplication of the tubercle bacilli in milk was noticed when milk was inoculated from any virulent tubercle serum sub-culture or from a previous milk culture in active growth. When, however, milk was inoculated directly from tubercular deposits there was noticeable delay in the first appearance of a growth. Milk cultures made from tubercular deposits of inguinal gland of guinea-pig or of the tubercular deposits in the omentum or spleen showed no active growth of tubercle bacilli at the end of two weeks. After four weeks active growth was observed, in the form of small and large masses and strands of tubercle bacilli in the bottom layers of the milk tube. Later still, there was no difficulty in ascertaining the presence of this active growth.

Virulence of Cultivation of Tubercle Bacillus in Milk.

Milk cultures made from a virulent serum culture, or directly from a tubercular deposit in an organ of the animal body, when inoculated subcutaneously or intraperitoneally into guinea-pigs prove highly virulent. The high virulence of such milk cultures was demonstrated by a number of experiments made on several guinea-pigs by subcutaneous inoculations with a few drops of such milk. The animals in each instance developed the swelling of the lymph glands rapidly: in 15 days the glands had become as large as a filbert, or even larger, and they showed much caseation. These animals generally died before a month was out, and post-mortem showed extensive tuberculosis of the viscera. But a further and very interesting fact came out. Milk cultures made from the perfectly non-pathogenic glycerine agar culture, mentioned above, proved to have a pathogenic action on the guinea-pig. The following experiments that have been made with such milk cultures indicate the extent and nature of this renewal of pathogenicity.

Series 1.—With about 0·1 c.c. of a milk culture made on May 15th, I inoculated on June 16th one guinea-pig (No. 1) subcutaneously in the groin, and another guinea-pig (No. 2) intraperitoneally. This milk culture contained numerous clumps of tubercle bacilli. It had been established on May 15th from one of the stock glycerin agar tubercle cultures kept by consecutive subcultures for over 10 years in the laboratory. On the same day that the above milk culture was used for inoculating the guinea-pigs its mother glycerin agar culture was used for inoculating a third guinea-pig (No. 3) subcutaneously, and a fourth guinea-pig (No. 4) intraperitoneally. Animals 3 and 4 received in each instance nearly as much as $\frac{1}{4}$–$\frac{1}{2}$ of a culture.

In a week's time guinea-pig No. 1 developed a distinct firm inguinal nodule of the size of a bean, guinea-pig No. 3 showed no glandular swelling.

Guinea-pig No. 1 was killed on July 6th, *i.e.*, 20 days after injection. Post-mortem examination showed in the groin of the

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inoculated side a big inguinal gland, containing caseous foci and also pus. The viscera appeared normal. The pus in film specimens showed crowds of free tubercle bacilli, in large and small clumps, and also tubercle bacilli enclosed within swollen leucocytes. Cultures prepared from this pus in milk and on serum* yielded pure growths of tubercle bacilli.

Guinea-pig No. 3 was killed on the same day. Post-mortem: the animal showed no swollen glands, or any other abnormality in the groin of the inoculated side; the viscera were normal. Film specimens made from the tissues of the groin failed to show any tubercle or other bacilli.

The intraperitoneally injected guinea-pig No. 2 was killed on June 28th, *i.e.*, after 12 days. On post-mortem examination numerous white nodules were found along the omentum and pancreas, some large and some small, firm, and containing necrotic foci. The spleen was covered with a whitish pseudo-membrane; the liver was pervaded by numerous minute white nodules. Film specimens of necrotic nodules in the pancreas, of the white membrane of the spleen, and of the white nodules of the liver, in each instance were found to contain tubercle bacilli. In the nodules of the pancreas they were present in great abundance, both singly and in groups. Cultures in milk and on serum from the pancreas nodules yielded good growths of the tubercle bacilli. Sections through the new growths in the pancreas and liver showed the tubercle bacilli very well.

Guinea-pig No. 4 was killed on the same day as No. 2, *i.e.*, June 28th. Post-mortem: the abdominal viscera, omentum, pancreas, spleen, and liver were quite normal.

From these experiments it would seem that while the original glycerine agar culture produced in guinea-pigs no pathological change, a milk culture made from it caused in other guinea-pigs multiplication of the tubercle bacilli, with accompanying pathological changes.

Series 2.—In this series a glycerine agar stock subculture was used on October 4th for establishing one milk and one serum subculture. At the same time one guinea-pig (No. 5) was inoculated intraperitoneally with a large dose of the stock subculture.

The milk subculture was examined on October 16th. It contained a copious crop of tubercle bacilli: the serum subculture on this day also showed a copious growth of tubercle bacilli. On the same day one guinea-pig (No. 6) was injected intraperitoneally from the milk subculture, and another guinea-pig (No. 7) intraperitoneally from the serum subculture.

Guinea-pig No. 5 was killed on November 20th, 35 days after inoculation. The result of post-mortem was wholly negative.

Guinea-pig No. 6 was killed 27 days after inoculation. Post-mortem examination showed numerous white nodules in the omentum and pancreas, partly caseous, partly purulent; the pus from these nodules was crowded with tubercle bacilli, and yielded good cultures in milk and serum; the liver, spleen and lungs seemed free of change.

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* In the majority of these experiments the culture serum employed was horse serum. See Addendum to this Report.

Guinea-pig No. 7 was killed 28 days after inoculation. The post-mortem examination showed several caseous nodules in the omentum and pancreas; no tubercle in the liver, spleen, or lungs. The caseous matter of the nodules in the omentum and pancreas showed crowds of tubercle bacilli, yielding good cultures in milk and on serum.

Series 3 (single experiment only).—From a laboratory stock of glycerin agar tubercle subculture a milk tube was inoculated on July 8th. On July 22nd this milk culture showed abundant growth of tubercle bacilli. A drop was injected into guinea-pig No. 8 subcutaneously. This animal died on February 12th. On September 15th, about two months after inoculation, no swelling could be detected in the groin; on November 6th, however, the glands in the groin were distinctly enlarged and firm; by December 8th they had become as large as a filbert, and there was an open sore in the groin. By December also the animal was showing distinct emaciation, and, as stated just now, it died on February 12th, about six months and a half after its inoculation. On post-mortem examination it showed typical and very advanced tuberculous changes in the inguinal glands, liver, spleen, omentum, pancreas, and lung. The bronchial glands were greatly enlarged, and full of purulent matter; this pus was crowded with tubercle bacilli, and on serum yielded a pure culture of the tubercle bacillus.

It is quite clear from these experiments that, although the bacilli of a stock glycerin agar tubercle culture may have lost all pathogenic action, yet they may regain pathogenicity when transferred to and grown in milk or serum.

In the next series several experiments were made with subcultures in milk established from a first generation of milk culture, made, as already explained, from a non-pathogenic glycerin agar stock culture.

Series 4.—(*a*) From a second generation milk subculture, which, seven days after inoculation showed a copious growth of tubercle bacilli in clumps and strands, guinea-pig No. 9 was injected subcutaneously in the groin on June 23rd.

This animal showed enlarged firm inguinal glands on July 8th. It was killed on July 13th, *i.e.*, after 21 days. On post-mortem examination the inguinal glands of the groin on the inoculated side were found to be enlarged to about the size of beans. They contained caseous and purulent matter, teeming with tubercle bacilli. The liver, spleen, and pancreas seemed unaffected; the bronchial glands were enlarged; in the lungs there were a few patches of consolidation. Cultures on serum from the bronchial glands yielded colonies of tubercle bacilli.

(*b*.) From a third generation milk subculture (made from the second generation just dealt with), which had been established nine days, guinea-pig No. 10 was injected intraperitoneally on

July 8th. This animal was killed 17 days later. Post-mortem: the omentum and pancreas were found transformed into thick white corded masses, composed of large and small tubercles, some firm and others caseous; the spleen was distinctly enlarged; the liver and lungs seemed normal. The caseous tubercles of the pancreas contained tubercle bacilli.

(*c.*) From a second generation milk subculture (made on July 22nd from the same first generation that was used for inoculation of guinea-pig No. 8 in series 3), guinea-pig No 11 was inoculated intraperitoneally on October 2nd. At that date the milk subculture was crowded with the tubercle bacilli. The animal was killed on November 20th (*i.e.*, after 49 days). On post-mortem examination it showed several small and large caseous and purulent nodules in omentum and pancreas; the other viscera seemed free of tubercle. The purulent matter of the nodules was crowded with tubercle bacilli, and yielded pure and copious growth in milk and on serum culture.

From this we see then that the pathogenic action of the tubercle bacilli regained by this transference from glycerin agar to milk is maintained in subsequent generations of subcultures in milk.

Series 5.—In this series experiments were made in order to ascertain whether the tubercular deposits, containing tubercle bacilli, which had been produced in guinea-pigs by inoculation of milk cultures derived from a non-pathogenic laboratory stock culture of tubercle bacilli on glycerin agar, themselves had pathogenic action when transmitted to further guinea-pigs, by inoculation in fairly large doses, about ½ c.c. of a turbid salt emulsion.

(*a.*) With an emulsion of the tuberculous nodules of the omentum and pancreas of guinea-pig No. 2, mentioned in Series 1, two guinea-pigs (Nos. 2a and 2b) were injected subcutaneously in the groin on June 28th.

No. 2a was killed on September 30th, *i.e.*, more than three months later. The result of post-mortem examination was wholly negative.

(*b*). With an emulsion of purulent matter from the inguinal gland of guinea-pig No. 1, mentioned in Series 1, one guinea-pig (No. 1a) was injected subcutaneously in the groin on July 6th. This animal was killed on September 30th, *i.e.*, about twelve weeks after. The result of post-mortem examination was wholly negative.

(*c.*) With an emulsion of the caseous tubercles of the omentum of guinea-pig No. 10, mentioned in Series 4 (*b*), one guinea-pig (No. 10a) was injected in the groin on July 25th. The animal was killed on September 30th, *i.e.*, after 66 days. The result of post-mortem examination was wholly negative.

(*d.*) With an emulsion of the caseous purulent tubercles of the omentum and pancreas of guinea-pig No. 6, of Series 2, on November 13th, 1899, one guinea-pig (No. 6a) was injected intraperitoneally, another (No. 6b) subcutaneously in the groin.

No. 6a was killed on April 2nd, 1900 (*i.e.*, about 4½ months later). The result of post-mortem examination wholly negative.

No. 6b was also killed on April 2nd, 1900. Result also wholly negative.

There is here the striking and somewhat unexpected result that tubercular matter of the guinea-pig, containing crowds of typical tubercle bacilli, and yielding on cultivation in artificial media typical cultures of tubercle bacilli, failed to produce any pathogenic effect when introduced into guinea-pigs in fairly large doses. Seemingly the tubercle bacilli which by prolonged cultivation on glycerin agar had lost their pathogenicity to guinea-pigs, and regained it when transferred to milk, had regained it to a strictly limited extent. The milk cultures could indeed produce tuberculosis in a guinea-pig, but the bacilli of the tuberculous lesions of the guinea-pig thus inoculated had so little virulence that they failed to produce tuberculosis when introduced, either subcutaneously or intraperitoneally, into other guinea-pigs. This is the more unexpected since one has come to look upon the body of the guinea-pig as a notoriously suitable medium for cultivation of the tubercle bacillus—more suitable than an artificial culture medium, such as milk. The experiments however prove that, in certain circumstances at any rate, this is not the case. The further question now arose:—In what way would the *artificial cultures* that had been produced from the tuberculous lesions of these milk-inoculated guinea-pigs behave when introduced into further guinea-pigs?

Series 6.—This series comprises seven animals, of which four were injected with small doses subcutaneously, and three intraperitoneally from milk or from serum subcultures, made from tuberculous matter taken from guinea-pigs of Series 1 and 2. In four animals the result was wholly negative, in one (subcutaneously inoculated) there was local result only, while two (intraperitoneally inoculated) yielded distinct general tuberculosis of the abdominal viscera.

These experiments were as follows:—

(*a.*) Guinea-pig No. 15, inoculated subcutaneously on July 15th, from one of the milk subcultures above referred to. Killed October 9th. Result of post-mortem examination negative.

(*b.*) Guinea-pig No. 17, inoculated subcutaneously on July 24th, from a serum subculture. Killed September 30th. A local tubercular abscess was found post-mortem.

(*c.*) Guinea-pig No. 20. Inoculated subcutaneously on August 1st, 1899, from a milk subculture. Killed April 3rd, 1900. Result of post-mortem examination negative.

(*d.*) Guinea-pig No. 21. Inoculated subcutaneously on October 2nd, 1899, from a serum subculture. Killed January 17th, 1900. Result of post-mortem examination negative.

(*e.*) Guinea-pig No. 29. Inoculated intraperitoneally on December 13th, 1899, from a milk subculture. Killed January 9th, 1900. Result of post-mortem examination negative.

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(*f.*) Guinea-pig No. 33. Inoculated intraperitoneally on January 8th, 1900, from a serum subculture. Killed January 27th, 1900. Post-mortem :—tubercles were found in omentum, pancreas, spleen, and liver.

(*g.*) Guinea-pig No. 34. Inoculated intraperitoneally on January 10th from a milk subculture. Killed March 5th. Post-mortem :—tubercles were found in omentum, pancreas, liver, and spleen.

From this it may be inferred that pathogenicity was very partially regained by cultivations on artificial media.

Growth of Tubercle Bacilli on Cheese.

Cheddar cheese, in blocks with slanting surface, was placed in test tubes and sterilised by steam. The slanting surface was then inoculated from a stock laboratory glycerin agar tubercle culture. The tube was capped and incubated at 37° C.

After incubation from between two and three months the culture tubes were inspected. No distinct indication of growth was observed, although it seemed under a glass as if the slanting surface of the cheese was covered with a thin filmy translucent layer. On making cover-film specimens with a platinum loop that had been drawn over the surface of the cheese, and staining in the usual way for tubercle bacilli, it was ascertained that these bacilli were actually present. On the cover film specimens the bacilli were in clumps and showed granular segregation of their protoplasm. The presence of the growth was further demonstrated by making a subculture on serum from the surface of the cheese. The serum tube after a fortnight's incubation at 37° C. showed good, typical, and pure growth of tubercle bacilli.

It may be noted here that the film specimens made from the above cheese culture showed, in addition to typical "acid-fast" tubercle bacilli, numerous other tubercle bacilli which were decolourised by nitric acid.

Virulence of tubercle bacilli grown on cheese.

A cheese culture, after keeping in the incubator for three and a half months, was used for subcutaneous inoculation of a guinea-pig. The slanting surface of the cheese was washed with a little sterile saline solution, and inoculation was performed with the washing—a slightly turbid emulsion containing numerous tubercle bacilli. The animal was killed after five months; result wholly negative.

Growth of tubercle bacilli in cream.

Pure cream was placed in test tubes, sterilised by steam, and then inoculated from a laboratory glycerin agar subculture of tubercle bacillus, and incubated at 37° C. After incubation for three months the cream showed no change in aspect. Cover glass film specimens and subcultures on serum were then made from it. These film specimens, stained in the usual way, showed numerous tubercle bacilli, both as isolated individuals and as small groups. The bacilli showed granular segregation of their protoplasm. A subculture on serum after a fortnight's incubation at 37° C. showed numerous colonies of tubercle bacilli.

Virulence of tubercle bacilli grown in cream.

From one of the above cream cultures, after three and a half months incubation, two guinea-pigs were inoculated, one intraperitoneally, and one subcutaneously. The former was killed after 6 weeks, the latter after 5 months. Results both wholly negative.

BACILLUS TYPHOSUS.

Growth of B. typhosus in milk.

It is well known that the typhoid bacillus grows luxuriantly in milk, both at 20° C. and at 37° C. It does not alter the fluid character of the milk; although it produces acid, as is well shown by the reddening produced when litmus milk is used as the culture medium.

Virulence of B. typhosus when grown in milk.

Milk cultures and broth cultures were made from the same laboratory stock subculture of B. typhosus. One set of milk and broth cultures were then incubated at 20° C., another set of each at 37° C. After incubation they were used for subcutaneous inoculation of guinea-pigs; milk and broth cultures which had been grown at 20° C., after 10 days incubation; those which had been grown at 37° C., after 5 days incubation. The result was in all instances the same; viz., after injection subcutaneously in the groin of ½ c.c. of either milk or broth culture, the animal showed next day at the seat of inoculation a slight soft tumour. This gradually enlarged, then became firmer, and either disappeared altogether or was followed by ulceration, which subsequently healed.

Growth of B. typhosus in cream.

(A.)—I inoculated sterile cream from a recent agar culture of typhoid bacillus and incubated it at 37° C. After a fortnight, during which period no apparent change in the cream had occurred, I made subcultures on agar and on gelatine. The former was incubated at 37° C., the latter at 20° C.

The result was nil, showing that there had been no multiplication of the typhoid bacilli in the cream incubated at 37° C., and that those bacilli which had been originally introduced had died.

(B.)—This series of experiments was carried out at the same time and under precisely the same conditions as those of series A. Sterile cream of the same stock and the same typhoid bacillus culture was used. The only difference was that while in series A the inoculated cream tubes were kept in the incubator at 37° C. those of series B were kept in the incubator at 20° C.

The result of this series was positive. Subcultures made after a fortnight on agar and on gelatine yielded copious typical growth of the typhoid bacillus. I repeated these experiments at both temperatures, and obtained the same results as before.

It appears then that cream kept at as high a temperature as 37° C. is not a suitable medium for the growth and multiplication of the typhoid bacillus, but that it is a suitable medium when kept at 20° C.

Growth of B. typhosus on cheese.

Portions of the same cheese which was used for the tubercle cultures already mentioned were sterilised and similarly used for establishing cultures of the typhoid bacillus. One set of these cheese tubes inoculated from a typhoid bacillus culture was incubated at 37° C., another set was incubated at 20° C. The result in both sets was negative, sub-cultures on agar and gelatine in every case proved sterile.

Both sets of experiments were repeated at a subsequent date, and yielded the same results. It may be inferred, therefore, that the typhoid bacillus does not grow and multiply when planted on cheddar cheese, at either of the temperatures used in these experiments.

BACILLUS DIPHTHERIÆ.

Growth in milk, cream, and cheese.

Experiments similar to those described in the case of the typhoid bacillus were made with bacillus diphtheriæ, using a recent active agar culture of the latter bacillus. Sterile milk, sterile cream, and sterile cheese contained in tubes were duly inoculated. One set of each was then placed in an incubator at 37° C., and another set in an incubator at 20° C. After a fortnight sub-cultures were made on agar and on gelatine, and the result noted.

The results were as follows :—

(*a.*) In milk, at 37° C. : no growth.
at 20° C. : copious typical growth.
(*b.*) In cream, at 37° C. : no growth.
at 20° C. ; no growth.
(*c.*) On cheese, at 37° C. : no growth.
at 20° C. : no growth.

It will be remembered that I have already drawn attention in a former report* to the fact that the diphtheria bacillus thrives incomparably better in milk at a comparatively low temperature, than at 37° C., and these present experiments fully confirm this. The negative results in cream and on cheese were rather unexpected, and I therefore repeated the experiments. The results, however, were the same as before.

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* Report of the Medical Officer, 1887-1888.

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STREPTOCOCCUS (CONGLOMERATUS) SCARLATINÆ.

Growth in milk, cream, and cheese.

In a former report I have pointed out that this streptococcus can readily be identified in a broth culture by its characteristics of forming fluffy white convoluted masses at the bottom of otherwise clear broth, by its power to rapidly curdle milk when growing at 37° C. in that medium, and by the characteristic aspect of its colonies (rounded flat translucent grey, with knobbed thickenings) on the surface of agar and gelatine. In the present series of experiments these characteristics were relied upon to indicate the presence of this streptococcus.

From a typical broth culture which had been incubated for 24 hours at 37° C., inoculations were made into (a) milk, (b) cream, and (c) cheese. As in the previous experiments, one set of tubes, in the case of each of these media, was incubated at 37° C., and another at 20° C. After a fortnight's incubation in each instance subcultures were made in broth, in milk, and on agar. The results were as follows :—

(*a.*) In milk, at 37° C. : typical growth.
at 20° C. : copious typical growth.
(*b.*) In cream, at 37° C. : no growth.
at 20° C. : limited, but typical growth.
(*c.*) On cheese, at 37° C. : no growth.
at 20° C. : limited, but typical growth.

The result of these several experiments shows that the behaviour of the four species of microbes tested is different in the different media when sterilized for the purpose of experiment. The tubercle bacillus is capable of growing in milk, in cream, and on cheese, at 37° C. The typhoid bacillus grows well in milk both at 37° C. and at 20° C.; it grows well in cream at 20° C., but does not do so at 37° C.; and it does not grow on cheese at either of these temperatures. The diphtheria bacillus, on the other hand, grows well in milk at 20° C., but not at 37° C., and it does not grow in cream or on cheese at either temperature. Finally the streptococcus scarlatinæ grows well in milk both at 37° C. and at 20° C.; it does not grow at 37° C. in cream or on cheese, and in both these media at 20° C. it shows only a limited growth.

ADDENDUM.

Certain points as regards the growth of tubercle bacillus on various media, brought out in the course of the foregoing experiments.

It may be interesting here to note an observation which I made in the course of this inquiry. The difficulty so commonly met

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with when trying to "start" a tubercle culture directly from a tuberculous organ of a guinea-pig affected with "inoculation tuberculosis" is easily obviated by using blood serum obtained from the horse instead of the usual ox-serum. I have over and over again started typical and pure colonies of tubercle bacilli on the slanting surface of solidified horse's blood serum directly from the tubercle of the liver, from the spleen, and from the caseous matter of swollen inguinal and bronchial glands of guinea-pigs affected with inoculation tuberculosis. Usually the method of inoculating these horse serum tubes has been to cut out with sterile scissors a portion of the caseous tubercle and to rub it over the surface of the serum with a sterile platinum loop. Another advantage that horse's blood serum seems to have is the greater rapidity with which the colonies make their appearance upon this medium. Koch originally showed that on ox-serum the appearance of colonies is first manifest 12 to 14 days after direct inoculation of the serum from the tubercles. Using horse serum however, the developing colonies can be distinctly recognised under a glass in some instances even in five days, and usually after eight days. Twelve to fourteen days after inoculation the colonies are fully established, and when transfer is made from colonies growing on horse serum to new horse serum, distinct and copious growth, visible in many instances with the unaided eye, will be developed in as short a time as three or four days after the subcultures have been made. An earlier appearance of growth when the inoculation has been made from an actively growing culture of tubercle bacillus than when tuberculous matter taken direct from the animal body has been inoculated, is however a fact not peculiar to horse's serum, but occurs with any medium in which the tubercle bacillus can maintain active growth. Migula has already pointed out (*System der Bacterien*, II. p. 494) that the statement that about twelve to fourteen days incubation at 37° C. is necessary for the first appearance of tubercle colonies is scarcely accurate if applied to transference of tubercle bacilli from an actively growing tubercle culture on a given medium to a second culture tube of medium of like sort. Clearly, if I take out of the incubator a tubercle culture growing on a particular serum, and take from this culture a particle of the growth and rub it over the surface of a new tube of similar serum, and then replace this new subculture in the incubator, there cannot have occurred more than a short temporary interruption in the growth and multiplication of the tubercle bacilli. In such case one would expect, what is indeed the case, that the growth of tubercle bacilli in the subculture would be rapidly established.

Recognition of Tubercle Bacilli in Articles of Food.

Ehrlich showed that tubercle bacilli, whether taken from the animal body, from artificial culture, or from any tubercular material, possess this chemical peculiarity; namely, that, after having been stained with fuchsin, they retain their colour, though they be well washed in strong solutions of mineral acid. This peculiarity, common to the tubercle and leprosy bacillus, is not possessed by most other microbes, which, when stained with fuchsin, become decolourised by acid. This method of Ehrlich's has been and is largely used for detection and diagnosis of tubercle bacilli. The materials to be examined, film specimens, sections, &c., are well stained with fuchsin, washed in mineral acid till all the red colouration has disappeared, then washed in water, and finally stained for contrast, generally with methyl-blue. By these means the tissue elements (including nuclei), having lost by the acid dip their original red colour, now take up the blue contrast colour, while the tubercle bacilli retain the red colour and are unaffected by the blue counter stain; wherefore in such preparations the tubercle bacilli are strikingly red, and easily recognised. This characteristic property of the tubercle (and leprosy) bacillus is spoken of as *acid-fast* (Säurefest of the Germans). Other microbes not possessed of this property may be denominated "acid-weak."

It is now known, however, that there are some few additional microbes other than tubercle and leprosy bacilli which possess this "acid-fast" character. Marpmann first pointed out that certain microbes in butter behave to a large extent like "acid-fast" bacilli, though in shape, manner, growth and pathological action they certainly cannot be mistaken for tubercle bacilli. To these are to be added the observations of Tavel on the "acid-fast" character of the "Smegma bacillus." Chiefly owing to these observations, it has been suggested that the fatty nature of the medium has something to do with the acquisition by the bacilli of the "acid-fast" character. And in recent years quite a number of observations have been recorded as to different species of bacilli—not tubercle bacilli nor leprosy bacilli—in milk, cream, butter, and also other materials, which are possessed of "acid-fast" character (Petri, Rabinovitsch). By their shape and size, their cultural character, and particularly by their action on experimental animals (some of them are possessed of pathogenic properties) these "acid-fast" microbes can be readily distinguished from the true tubercle bacilli.

I have myself several times, in samples of milk, come across "acid-fast" bacilli which were not tubercle bacilli. They were distinctly pointed and spindle-shaped; they were shorter and thicker than the tubercle bacilli, and they were devoid of pathogenic action.

These facts indicate that it is unsafe to put too much reliance merely upon the "acid-fast" character of the tubercle bacillus. Other characteristics, namely, its shape, its cultural characters, and above all its definite pathogenic action are, however, so definite that no experienced observer who subjects a given material, *e.g.*, milk, cream, or butter, suspected to contain tubercle bacilli, to all these tests can fail to arrive at a correct determination.

I would not be understood to mean that confirmation in all these ways is essential in all circumstances for the accurate diagnosis of tubercle bacillus. If, for instance, we find as regards any suspected tissue (human or animal),[*] pulmonary sputum, pus, or caseous matter, that by using the proper methods of staining[*] and counter-staining, "acid-fast" bacilli *of typical slender bacillary shape*, showing the *segregation of their protoplasm*, arranged here and there in clusters, or perhaps in the case of a section being contained within giant cells, I would not hesitate to make at once the diagnosis "true tubercle." For in no other disease would such results be obtained.

On occasion, however, and particularly when we endeavour to detect tubercle bacillis in articles of food such as milk, butter, &c., it may be essential to confirm the diagnosis that an acid-fast bacillus is that of tubercle by obtaining the characteristic growth of tubercle bacillus in artificial media, and by inoculation of guinea-pigs. I have already mentioned that I have found the slanting surface of solidified horse serum serves well as a cultivation medium, and that its special suitability is shown by the fact that ordinarily on horse serum there is no difficulty in obtaining pure cultures of typical colonies of tubercle bacilli from tubercular deposits of the organs of guinea-pigs affected with inoculation tuberculosis. When horse serum culture tubes have been inoculated with the suspected material, and have been incubated at 37° C. for several days, and no growth of any kind has appeared, the presumption is strong that no saprophyte or ordinary microbe, other than the tubercle bacillus, has been introduced, If tubercle bacilli have been introduced, then after seven, eight, or more days there can be seen, with the aid of a glass, minute grey, slightly angular colonies; and as time proceeds, these colonies become more raised, whitish, and angular. Such colonies are typical of the tubercle bacillus. If a particle of a colony (as a rule the colony as a whole sticks to the point of the needle) is now taken and cover film specimens are made of it, and if these, after staining by the above method, show typical "acid-fast" slender rods, with segregation of protoplasm, and arranged in the characteristic festooned wavy strands and masses, then the diagnosis "tubercle bacillus" may be considered well established. Subcultures made from a colony on a fresh serum surface and production thereby of inoculation tuberculosis in guinea-pigs will quite fully establish the diagnosis.

Early in this inquiry I noticed that, in the incipient stages of the growth of what is unmistakeably "tubercle bacillus," film specimens stained and treated in the manner above described show that numbers of the bacilli are anything but "acid-fast;" they having lost the fuchsin colour and having taken up the blue colour of the contrast stain. For example, there will be in places strands of tubercle bacilli in which perhaps a majority are of the normal "acid-fast" character while a minority, either scattered individuals or clusters of bacilli, are distinctly "acid-weak," having been stained blue (Fig. 49, Plate XIX.). I have preparations in which these appearances are extremely striking. In them are strands of red (acid-fast) tubercle bacilli, from which pass out on one side minor strands in which a few blue bacilli are mixed up with the red ones, and on the other side there are strands, composed principally of blue bacilli having amongst them a few red bacilli. In addition there are minor strands in which most of the bacilli appear of a purplish or violet colour, as if they had not quite lost the original red but taken up also some of the blue colour. Be it remembered that I am not speaking here of specimens obtained from a diffuse growth over a large serum surface, but of discrete isolated colonies. I am dealing too with these colonies in the earlier stages of their growth. If the same culture were examined in later phases of growth, for example when many weeks old, it would show only "acid-fast" bacilli.

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[*] The method of staining, which I think, with others, can be thoroughly relied upon in such examinations, is one which is commonly used, viz., the cover-glass film specimens are placed in Ziehl's carbol fuchsin and heated till the fuchsin boils, they are then superficially washed in water, then thoroughly washed in nitric acid, 33·3 per cent., for 10 to 15 seconds; after this thoroughly washed in water and counter-stained in methyl-blue anilin water for about ¼ to ½ a minute, and finally again washed well in water, dried and mounted in xylol balsam. In my experience no microbe in animal tissues which has slender cylindrical shape and segregated protoplasm will retain its red colour when thus treated except the true tubercle bacillus

In the case of cultures of tubercle bacillus on horse serum, "acid-weak" bacilli will be best observed in specimens from cultures 11 to 14 days old: later than this only a few scattered "acid-weak" bacilli will be met with. Still later (after a month and more) they are lost altogether. The first specimens that I obtained which showed the early "acid-weak" phase of the tubercle bacillus were made from glycerine agar subcultures, and from cultures on horse's serum which were attenuated in virulence, and I thought that the attenuation of the virulence might have something to do with the occurrence. I soon found, however, that the same modification in staining property takes place, though to a lesser degree, in the case of fully virulent cultures. There seems, however, to be some degree of correspondence between the numerical proportion of "acid-weak" bacilli in a culture and the degree of attenuation of virulence of that culture. This applies only to the early stages of the growth; for in such highly-attenuated cultures as those on glycerine agar incubated long enough, *e.g.*, a month or more, the growth consists entirely of "acid-fast" bacilli.

The meaning of this "acid-weak" phase in the early stage of growth of many tubercle bacilli in culture in artificial media is not altogether clear. According to a generally accepted view, which has been indicated above, the "acid-fast" character of tubercle bacilli is due to some kind of fatty envelope or fatty material which they possess. This view is supported by the fact that, according to Marpmann and other later writers (Petri, Rabinovitsch), not only is such an "acid-fast" character possessed by bacilli other than tubercle when present in milk, butter, and similar fatty materials, but also by this circumstance that bacilli ordinarily not possessed of "acid-fast" character, can by growing in fatty materials acquire this character (Marpmann). But in view of the facts observed in the case of horse serum cultures, this explanation hardly suffices; for the nature of the serum in the culture, as far as fat is concerned, remains the same throughout the whole period of growth of the bacilli on the serum. One might, of course, surmise that by the progressive growth of the tubercle bacilli some fatty matter becomes split off from the albuminous matter of the serum. But as to this I am unable to offer any evidence either one way or the other. On the whole, it appears to me more probable that the chemical constitution of the bacalli themselves—their sheath and protoplasm—is not the same in the several phases of growths on certain artificial media, and that in the earlier phases the bacilli are deficient of that particular ingredient by which they obtain the "acid-fast" character. Whatever the true explanation may be, the observation appears to have an important practical bearing. The possibility that true tubercle bacilli may escape detection in a given material by the single method of searching under the microscope for "acid-fast" bacilli will in future have to be borne in mind.

No. 9.

PRELIMINARY ACCOUNT of the RESULTS of a BACTERIOSCOPIC ANALYSIS of DIFFERENT CEREALS and FOOD-STUFFS, by DRS. E. KLEIN and A. C. HOUSTON.

APP. B, No. 9.

On Bacterioscopic Analysis of Cereals, &c.; by Drs. Klein and Houston.

On various occasions outbreaks of disease having been referred to cereal food-stuffs, these have come under suspicion of conveying infection through bacterial agency. We have, therefore, as a first step towards elucidating this question, subjected various kinds of grain, such as oats, wheat, and rice to bacterioscopic examination, with a view, first: to ascertain what kind of bacteria may be considered as normally and commonly associated with them, and, further, whether in addition any, and if so, what. pathogenic microbes are comprised amongst them.

The samples of grain that were thus subjected to bacteriological analysis were as follows ;—

No. 1. American wheat.
No. 2. American oats.
No. 3. Canadian oats.
No. 4. Scotch oats.
No. 5. Russian oats, Libau.
No. 6. Russian oats, Vologda (black).
No. 7. Russian wheat.
No. 8. Canadian wheat.
No. 9. Swedish oats.
No. 10. Calcutta wheat.
No. 11. New Zealand wheat.
No. 12. Australian wheat.

The above twelve samples were obtained from a wholesale firm. In addition to these cereals, we have examined :—

No. 13. Sample of rice, bought at provision dealers, City.
No. 14. Sample of rice, bought at provision dealers, Lambeth.
No. 15. Sample of flour, bought at grocers' shop, City.
No. 16, Sample of flour, bought at grocers' shop, Lambeth.
No. 17. Sample of "coarse" oatmeal, bought at grocers' shop, City.
No. 18. Sample of "fine" oatmeal, bought at a grocers' shop, Lambeth.

The amount of work which was called for in the course of the inquiry became so extensive, and the number of cultivations and animal experiments increased to such proportions, that we are unable, for the present, to do more than consider the following points :—

(*a.*) What microbes were either habitually or commonly associated with these several food-stuffs ?

(*b.*) Did any of these food-stuffs contain bacillus coli, or the spores of the virulent bacillus enteritidis, or both ?

In what follows, reference will also be made to other microbes only occasionally present in these food-stuffs, but which from one cause or another especially attracted our attention during the course of this investigation.

As regards the samples of grain and rice, it seemed probable that microbes associated with these food-stuffs would only be "attached" to the outside of the grains, having reached them either from the soil on which they were originally grown, or through dust with which in the course of their handling they became contaminated. Consequently all that seemed to be necessary was to "wash" the grains in each instance in a small quantity of sterile salt solution, and to use this "washing" for cultivation. But it was found in the course of the investigation that for the detection of certain microbes, present in small proportions, the above method had to be modified. Thus, in some of the experiments, the grains in fair number were added directly to the culture medium, in order to allow the detection of the micro-organisms in question.

SECTION I.—MICROBES, which ATTRACTED ATTENTION in the COURSE of the INQUIRY, as HABITUALLY or OCCASIONALLY PRESENT on the VARIOUS SAMPLES of GRAIN.

The following microbes were usually isolated from surface agar plates, to which several drops of the "washings" of the several samples of food-stuffs had been added, and by subsequently making the necessary subcultures.

The result of a large series of culture experiments with the above samples are as follows :—

(1.) With the exception of sample No. 11 (New Zealand wheat) all other samples of wheat, oats and rice, yielded a minute bacillus, doubtful as regards motility, forming, on surface agar at 37° C., round flat colonies, citron-yellow in colour, and moist and translucent in appearance. In streak on agar, the growth is, after some days, of a distinctly lemon yellow colour, and after about a week numerous deeper-yellow round knob-like aggregations appear in the lemon-coloured growth. This micro-organism liquefies gelatine in stab-culture, the liquefied gelatine remains clear, while on the top and at the bottom appear masses of growths which vary in colour from citron-yellow to orange. This bacillus is without any pathogenic action when administered either intraperitoneally or subcutaneously to the guinea-pig.

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We propose to speak of this microbe provisionally as bacillus citreus cerealis.

(2.) A second microbe, which occurred in the majority of samples, is one resembling the above bacillus citreus, in that it forms on agar at 37° C. a lemon-coloured expansive growth, with a thinner translucent margin; but, unlike the microbe described in (1), it does not form, after a week or more of cultivation, any deep yellow, round, knob-like aggregations. It too liquefied gelatine with yellowish deposit, but the liquefaction was much less rapid than in (1). We may however consider this microbe as a variety of the bacillus citreus cerealis. It had no pathogenic action.

(3.) *Bacillus subtilis.*—The spores of this bacillus were found in about half the number of samples.

(4.) *Bacillus mesentericus ruber* (and allied forms).—The spores of this microbe were present in several samples.

(5.) A motile thin cylindrical bacillus, forming translucent round colonies on agar plate at 37° C. In streak culture on agar it forms a translucent flat expansive growth: gelatine is liquefied by it fairly rapidly, the liquefied gelatine becoming faintly turbid, and distinctly fluorescent: at the bottom of the liquefied gelatine occurs a powdery floccular grey deposit. This bacillus does not form spores, and is without any pathogenic action. It was found on sample No. 3 only (Canadian oats).

(6.) *Staphylococcus membranaceous.*—The coccus, provisionally so-called, was found on the following samples: 2, 3, 5, 7, 9. It grew rapidly on agar forming a whitish dry membranous expansive growth with branched leaf-shaped annexes: it liquefied gelatine, which became turbid. Even in large doses it produced no pathogenic effect.

(7.) *Mucor mucedo.*—The spores of this mould were present in large numbers on sample No. 10 (Calcutta wheat), where most of the colonies were those of this mucor. The mycelia, as also the sporangia, were injected in large amounts into guinea-pigs, subcutaneously and intraperitoneally, but produced no result.

(8.) *Streptococci.*—Several species (varieties?), more or less closely resembling streptococcus brevis. These occurred in more than half of the samples, viz., samples 1, 2, 3, 4, 5, 6, 12. They were found to be non-pathogenic to mice.

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SECTION II.—RESULTS, as REGARDS the PRESENCE of the SPORES of B. ENTERITIDIS SPOROGENES, in the ABOVE SAMPLES of "FOOD-STUFFS."

SERIES I.

In this series, a dozen grains of each of the different cereals 1 to 12 were added severally to test-tubes, each containing 5 cc. of sterile salt solution. After 24 hours (at the room temperature), 2 cc. of the liquid were withdrawn by means of a sterilised pipette from each of the tubes, and added to sterile milk (about 15 cc.) tubes. The milk tubes were next heated to 80° C. for ten minutes, and then placed under anaërobic conditions in the hot incubator (37° C.).

The results obtained are shown in the following table :—

TABLE I.

SHOWING the results as regards the presence of spores of B. enteritidis sporogenes in Series I.

Experiment.	Description of the Cereal	Amount of the Cereal used in making the Cultures in Milk.	Results as regards the presence of Spores of B. Enteritidis Sporogenes.	Results as regards the Virulence of the Milk Culture [1 cc. subcutaneously in a guinea-pig].
1	(1.) American wheat	In each case 2 cc. of the 5 cc. "washings" of 12 grains of the cereal.	+ (but not quite typical).	Slight local reaction, otherwise animal unaffected.
2	(2.) " oats		—	...
3	(3.) Canadian "		—	...
4	(4.) Scotch oats		—	..
5	(5.) Libau Russian oats... ...		+	Same as experiment 1.
6	(6.) Vologda Russian oats ...		+ (but not quite typical).	Distinct swelling and animal poorly. Recovery took place.
7	(7.) Russian wheat		—	...
8	(8.) Canadian wheat		—	...
9	(9.) Swedish oats		—	...
10	(10.) Calcutta wheat		+ (but not quite typical).	Same remarks as experiment 1.
11	(11.) New Zealand wheat ...		—	...
12	(12.) Australian wheat		—	...

SERIES II.

APP. B, No. 9.

On Bacterioscopic Analysis of Cereals, &c.; by Drs. Klein and Houston.

In this series the same cereals 1 to 12 were used, but in much larger quantities. The procedure was as follows :—

In each case 1 gramme of the cereal was added directly to a sterile milk tube. The tube was then heated to 80° C. for 10 minutes and cultivated at 37° C., under anaërobic conditions.

The results obtained are shown in the following table :—

TABLE II.

SHOWING the results as regards the presence of spores of B. enteritidis sporogenes in Series II.

Experiment.	Description of the Cereal	Amount of the Cereal added to the Milk Culture.	Results as regards the presence of Spores of B. Enteritidis Sporogenes.	Results as regards the Virulence of the Milk Culture [1 cc. subcutaneously in a guinea-pig.]
1	(1.) American wheat	1 gramme	—	...
2	(2.) „ oats	„	+	Dead (24 hours).
3	(3.) Canadian „	„	+	Dead (24 hours).
4	(4.) Scotch oats	„	+	Only a slight local reaction, animal recovered.
5	(5.) Libau Russian oats... ...	„	+	Dead (24 hours).
6	(6.) Vologda „ „ ...	„	+	Dead (48 hours).
7	(7.) Russian wheat	„	+	Dead (24 hours).
8	(8.) Canadian „	„	+	Dead (72 hours).
9	(9.) Swedish oats	„	+	Dead (24 hours).
10	(10.) Calcutta wheat	„	+	Dead (24 hours).
11	(11.) New Zealand wheat ...	„	+	Dead (24 hours).
12	(12.) Australian wheat	„	+	Enormous swelling. Later suppuration and ulceration of abdominal wall. Recovery took place.

In Series I., samples 1, 5, 6, and 10, alone had yielded a positive result, and in these the changes in the milk culture were not quite typical in 1, 6 and 10. In all the other experiments the result had been wholly negative. Where results had been obtained, as regards the inoculation of guinea-pigs, a local reaction was observed, but in each case the cultures were non-virulent.

These results contrast with those obtained in Series II. Here in each instance a much larger quantity of the cereal was used, namely, 1 gramme. The result was positive in all the experiments except sample 1 (which, curiously enough, had yielded a positive result in Series I). In this series the cultures of B. enteritidis were for the most part highly virulent. In seven of the experiments (samples 2, 3, 5, 7, 9, 10, 11), the guinea-pig died within 24 hours; in experiment 6 (sample 6), in 48 hours; and in experiment 8 (sample 8), in 72 hours. In experiment 4 (sample 4), the subcutaneous inoculation of 1 c.c. of the milk culture produced only a temporary and local reaction, but in experiment 12 (sample 12), although the animal eventually recovered, it suffered from "floating belly" and, later, ulceration of the abdominal wall.

Thus in seven out of eleven samples of grain in which B. enteritidis was detected, the milk cultures were highly virulent In two others the cultures were less (but still decidedly) virulent. In the case of one other sample the reaction was only a local and. temporary one, and in the remaining case, although the guinea-pig did not succumb, it remained extremely ill for a considerable time, and the reaction was very typical of the effects ("floating belly," &c.) produced by B. enteritidis sporogenes.

Series III.

Results, as regards the presence of Spores of B. Enteritidis Sporogenes, in rice, flour, and oatmeal.—Samples 13–18 :—

Sample of Rice, No. 13.—About 20 to 30 rice-grains were added to 5 cc. sterile salt solution; after shaking well up for some minutes, 2 cc. of the fluid were added to milk, and this was heated for 10 minutes at 80° C., and then incubated anaërobically at 37° C. After 27 hours the milk was typically changed, and on injection into a guinea-pig proved highly virulent.

Sample of Rice, No. 14.—About 20 to 30 rice-grains were added to 5 cc. sterile salt solution, and after shaking well up, 2 cc. of the fluid were added to milk, heated for 10 minutes at 80° C., and then incubated anaërobically at 37° C. No change occurred in this milk.

The experiment was repeated, but with this difference, that 30 rice-grains were added directly to the milk. After 27 hours' incubation the milk was typically changed, and proved virulent to the guinea-pig.

Sample No. 15, Flour.—About 2 grammes of the flour were placed in 5 cc. sterile salt solution: after shaking well for some minutes, 2 cc. of the fluid were added to milk. The result was negative qua spores of bacillus enteritidis. The same negative result was obtained after adding 1 gramme of the same flour direct to the milk.

Sample No. 16, Flour.—In this instance 1 gramme of the flour was added direct to the milk. Result, negative.

Sample No. 17.—Oatmeal: One gramme of the oatmeal was added to milk. Result, negative.

Sample No. 18.—Oatmeal: one gramme of the oatmeal was added to milk. Result: typical change of the milk in 24 hours, the whey proving highly virulent to a guinea-pig.

In these experiments the two samples of rice and a sample of fine oatmeal were found to contain the spores of the bacillus enteritidis; but both samples of flour and a sample of coarse oatmeal were free of them, so far as may be judged from the amounts used. In sample No. 14 of this series the difference between using the mere washing of a few grains of rice and adding the rice direct and in larger quantity, was very apparent.

It may be permissible here to mention that, as was pointed out in last year's report by one of us, presumptive evidence of the strongest kind was forthcoming that rice, as rice pudding, had been the cause of an epidemic outbreak of severe diarrhœa at St. Bartholomew's Hospital.

SECTION III.—RESULTS as REGARDS the PRESENCE of BACILLUS COLI (and ALLIED FORMS) in the ABOVE SAMPLES OF "FOOD-STUFFS."

SERIES I.

In this series 12 grains of each of the different cereals 1 to 12 were added severally to test tubes, each containing 5 cc. of sterile salt solution. After 24 hours (at the room temperature), 1 cc. of the liquid was withdrawn, by means of a sterilised pipette, from each of the tubes and added to sterile phenol (0·05 °/₀) broth tubes. The broth tubes were incubated for 48 hours at 37° C., and thereafter surface phenol gelatine plates were made from each of them.

As regards the original broth cultures:—All the 12 cereal samples gave rise to diffuse turbidity in the broth cultures. In 1, 3, and 4 a grease-like scum showed itself on the surface; in 11 a firm pellicle was noted, and in most of the tubes there was a suspicion of surface-scum formation. Tested on the 5th day of incubation at 37° C. for indol, the following results were obtained:—Cereals, 3, 4, 6, 7, 10, and 12, no indol; 1 and 8. slight indol; 2, 5, 9, and 11, strong indol.

Next as regards the surface phenol gelatine plates from the broth cultures:—

No. 1. American wheat: some coli-like colonies.
No. 2. American oats: no coli-like colonies.
No. 3. Canadian oats: no coli-like colonies.
No. 4. Scotch oats: no coli-like colonies.
No. 5. Russian oats (Libau): many coli-like colonies.
No. 6. Russian oats (Vologda): no coli-like colonies.
No. 7. Russian wheat: some coli-like colonies.
No. 8. Canadian wheat: no coli-like colonies.
No. 9. Swedish oats: almost pure culture of a coli-like microbe.
No. 10. Calcutta wheat: some colonies remotely like bacillus coli.
No. 11. New Zealand wheat: great many coli-like colonies.
No. 12. Australian wheat: no coli-like colonies.

SERIES II.

In this series a much larger quantity of the cereals was employed, namely: 1 gramme in each case. Further, the cereals were added directly to the phenol (0·05°/₀) broth cultures without preliminary immersion in water.

As regards the original broth cultures (containing severally 1 gramme of cereals 1 to 12, both inclusive):—

All the 12 cereals gave rise to diffuse turbidity in the broth cultures, and, with the exception of (8), all the tubes gave a positive result as regards the indol test as early as the 2nd day (37° C.).

Next as regards the surface phenol gelatine plate cultures from the broth cultures:

No. 1. Coli-like colonies.
No. 2. No coli-like colonies.
No. 3. No coli-like colonies.
No. 4. Colonies resembling B. coli.
No. 5. No coli-like colonies.
No. 6. No coli-like colonies.
No. 7. Some coli-like colonies.
No. 8. No coli-like colonies.
No. 9. No coli-like colonies.
No. 10. No coli-like colonies.
No. 11. No coli-like colonies.
No. 12. Colonies remotely resembling B. coli.

In the following table (Table III.) a detailed account is given of the results of sub-cultures of the colonies on gelatine which were either indistinguishable from B. coli or were suspected of having kinship with that microbe:—

Table III.

Showing the results as regards the presence of B. coli and allied forms.

Experiments.	Description of the Micro-organism.	Gas formation (Gelatine "Shake" Culture).	Broth Culture (37° C.). (a) Diffuse Turbidity, (b) Indol.	Litmus Milk Cultures (37° C.) (a) Acid. (b) Clot.	Animal Experiments.	Remarks.
	Series I.					
1	? B. coli 1. Cereal 1 .. [In Experiments 2, 3, and 4 no B. coli noted.]	+ 24 hours	(a) + 24 hours. (b) Trace, 4th day.	(a) + (b) −	0·5 cc. broth culture subcutaneously in guinea-pig. Not pathogenic.	After some weeks liquefaction of the gelatine occurred. Colonies in gelatine typical of B. coli.
5	? B. coli 5. Cereal 5 .. [In Experiment 6 no B. coli noted.]	+ 24 hours	(a) + 24 hours. (b) Trace, 4th day.	(a) + (b) +	Do.	No liquefaction even after 5 weeks. Colonies in gelatine typical.
7	? B. coli 7. Cereal 7 .. [In Experiment 8 no B. coli noted.]	+ 24 hours	(a) + 24 hours. (b) − 8th day.	(a) + (b) Weak clot, 8th day.	Do.	After 3 weeks slight liquefaction of gelatine. Colonies in gelatine atypical.
9	? B. coli 9. Cereal 9 ..	+ 24 hours	(a) + 24 hours. (b) + 8th day.	(a) + (b) −	Do.	No liquefaction (4 weeks). Colonies in gelatine typical.
10	? B. coli 10. Cereal 11 ..	−	(a) ? + (b) − 8th day.	Alkaline change and no clot.	Do.	No liquefaction (4 weeks). Colonies in gelatine atypical.
11	? B. coli 11. Cereal 11 .. [In Experiment 12 no B. coli noted.]	+ 24 hours	(a) + 24 hours. (b) − 8th day.	(a) + (b) Weak clot, 8th day.	Do.	No liquefaction (4 weeks). Colonies in gelatine typical.
	Series II.					
1	? B. coli 1. Cereal 1 .. [In Experiments 2 and 3 no B. coli noted.]	+ 24 hours	(a) + 24 hours; later some scum and flocculent turbidity. (b) − 5th day.	(a) + (b) Weak clot, 5th day.	0·5 cc. broth culture subcutaneously in guinea-pig. Not pathogenic.	By 18th day slight liquefaction of gelatine. Colonies in gelatine plate and streak cultures atypical.
4	? B. coli 4. Cereal 4 .. [In Experiments 5 and 6 no B. coli noted.]	+ 24 hours	(a) + 24 hours; later slight scum and trace of flocculent turbidity. (b) − 5th day.	(a) + (b) + 6th day.	Do.	Do. do.
7	? B. coli 7. Cereal 7 .. [In Experiments 8, 9, 10, and 11 no B. coli noted.]	+ 24 hours	(a) + 24 hours; later distinct scum and some flocculent turbidity. (b) − 5th day.	(a) + (b) Weak clot, 8th day.	Do.	Do. do.
12	? B. coli 12. Cereal 12 ..	+ 24 hours	Do.	(a) + (b) + 8th day.	Do.	Do. do.

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On Bacterioscopic Analysis of Cereals, &c.; by Drs. Klein and Houston.

In considering these results, it is to be noted that in experiments 2, 3, 4, 6, 8 and 12, Series I., and experiments 2, 3, 5, 6, 8, 9, 10 and 11, Series II., no colonies at all like B. coli were found in the cultures. In experiments 1, 5, 7, 9, 10 and 11, Series I., and experiments 1, 4, 7 and 12, Series II., colonies occurred in the cultures, either indistinguishable from B. coli, or sufficiently like it to merit subculture. As regards Series I., subcultures of bacteria suspected of being B. coli were made in four out of the six samples of wheat, and in two out of the six samples of oats. As regards Series II., similar subcultures were made in three out of the six samples of wheat, and in only one of the six samples of oats. Taking both series together, subcultures of bacteria resembling B. coli were made in eight out of the 12 samples of cereals, five of the eight being from samples of wheat, and three from samples of oats. So that at this stage the samples of wheat appeared to contain more B. coli (and allied forms) than the sample of oats.

Next as to the results of subculture of these colonies suspected of kinship with B. coli.

It is to be noted that all the colonies in Series II. (experiments 1, 4, 7, 12) were slow liquefiers, and that their growth in gelatine plate and streak cultures was atypical. Yet were they far from being atypical in other respects; thus they all gave "gas" in gelatine shake culture in 24 hours; acidity and clotting of milk, and diffuse turbidity in broth cultures. None of them gave indol in broth culture (5th day). But many strains of B. coli, freshly isolated from sewage, also fail in this respect. Some of the broth cultures were, in the later stages of their growth, atypical in that the turbidity became flocculent in character, and a distinct surface scum developed. Some strains of B. coli produce a faint "ring-scum" in broth cultures, and possibly even a suspicion of flocculent turbidity, but not to the extent noted in the microbes of the subcultures under consideration.

As regards Series I., the micro-organism resembling B. coli in experiment 10 may be dismissed because it produced no "gas" in gelatine "shake" culture; atypical turbidity in broth, and no indol; and an alkaline change and no clot in milk culture. The microbe examined in experiment 7 seemed to come under the same category as the slow liquefiers discussed in Series II., except that the growth in broth cultures was more like that of B. coli. The microbe of experiment 1 appeared in every way typical of B. coli, except that it did not clot milk. But a delayed power of clotting milk, or an absence of ability to clot milk, is extremely common among strains of microbes, freshly isolated from sewage, which are nevertheless to be thought of as of extremely close kinship to B. coli. However, this microbe finally, although very slowly, liquefied gelatine, which many bacteriologists would consider a fatal objection to its inclusion in the coli class. There remain the microbes of experiments 5, 9, and 11, all of which appeared to resemble B. coli sufficiently closely to merit a positive result being recorded. The first two of these were obtained from samples of oats, and the last from a sample of wheat.

These results as to grain testing, as a whole, suggest that typical B. coli is not a common inhabitant of commercial wheat and oats, but that microbes more or less closely allied to B. coli, are apt to be present in a majority of samples.

None of the micro-organisms in question, whether or not they could be termed typical B. coli from their cultural characteristics, were pathogenic under the conditions of the experiments.

SERIES III.

Results as regards the presence of Bacillus Coli in samples of Rice, Flour, and Oatmeal: Samples 13–18 :—

In this series, as in the case of the experiments for identifying the spores of bacillus enteritidis, two sets of experiments were made: (*a*) washing the materials first in 5 cc. of sterile salt solution, and then adding 0·5 cc. of this fluid to phenol-broth; (*b*) by adding 1 gramme of the material directly to the phenol-broth.

After incubation of the phenol-broth at 37° C. for 24 hours in each instance, phenol-gelatine surface plates were made. Colonies resembling B. coli were then subcultured in phenol-broth, litmus milk, and in gelatine shake.

The result was as follows :—

No. 13. Rice, experiment *a*: no bacillus coli.
„ experiment *b*: no bacillus coli.
No. 14. Rice, experiment *a*: no bacillus coli.
„ experiment *b*: typical bacillus coli.
No. 15. Flour, experiment *a*: no bacillus coli.
„ experiment *b*: no bacillus coli.
No. 16. Flour, experiment *a*: no bacillus coli.
„ experiment *b*: typical bacillus coli.
No. 17. Oatmeal, experiment *a*: no bacillus coli.
„ experiment *b*: no bacillus coli.
No. 18. Oatmeal, experiment *a*: no bacillus coli.
„ experiment *b*: typical bacillus coli in abundance.

From these experiments it appears, that one set of the materials, rice, flour, and oatmeal, bought in each instance in a large shop in the City, failed to give evidence of the presence of bacillus coli, either when a larger or a smaller quantity was used for experiment. Whereas the other set of similar materials bought in Lambeth, when used in the larger quantity, was found in each instance to contain bacillus coli. Here again it should be mentioned that none of the samples of bacillus coli above referred to had any special pathogenic action when inoculated subcutaneously into guinea-pigs.

There would seem to be no special advantage in discussing these results taken as a whole, since our investigations are still in progress. Nevertheless, it may not be amiss to make certain provisional observations by way of summary:—

(1.) Virulent B. enteritidis sporogenes was present in a majority of the food-stuffs which we examined, namely, wheat, oats, rice, oatmeal, and wheat flour.

(2.) Typical B. coli was by no means habitually present in these food-stuffs, though microbes which may be suspected of having kinship to B. coli were comparatively frequently met with.

(3.) In some of the samples, microbes seemingly closely akin to streptococcus brevis, were discovered.

(4.) It was not found, contrary perhaps to what might have been expected, that the predominant micro-organisms in these food-stuffs were those commonly associated with cultivations made from soil.

(5.) With the exception of B. enteritidis sporogenes, the various microbes met with in the investigation proved to be non-pathogenic.

(6.) Although to some extent each different kind of the food-stuffs examined possessed a bacterial flora of its own, nevertheless certain microbes — in particular members of a group of chromogenic bacilli provisionally termed B. citreus cerealis (and its varieties)— were specially abundant in nearly all the samples of these different food-stuffs.

No. 10.

OBSERVATIONS on the BACTERIA found in CALF LYMPH during the process of GLYCERINATION; by Mr. H. S. FREMLIN.

APP. B, No. 10.

On Bacteria in Glycerinated Calf Lymph: by Mr. Fremlin.

This report deals with the bacteriological examination of the vaccine material collected from 500 calves during 1899 and the early months of 1900.

The lymph pulp from each calf is, when brought to the Laboratories, subjected to bacteriological examination in the following way:—

Immediately after trituration and admixture of the lymph with glycerine, a loopful of the resulting emulsion is shaken up in bouillon agar, which, having been previously liquefied by heat, has cooled sufficiently to allow of addition of the lymph emulsion without risk of injury to the micro-organisms contained therein.

From the dilution thus obtained other agar tubes are similarly inoculated, each with a loopful, and the contents of these tubes and of the original tube are poured into sterilised Pétri dishes in the usual way.

These plate cultivations having been incubated at 37° C. for 48 hours, are then removed to an incubator at 18—20° C., in which they are kept for 5—7 days to allow further development of micro-organisms.

After incubation for a total period of 7—9 days, the colonies that have appeared upon the original agar plate, that is to say that containing a whole loopful of the emulsion, are counted by means of Ehrlich's counting apparatus. Thus is ascertained the number of micro-organisms contained in a loopful of glycerinated emulsion (a loopful corresponds approximately to ¼ of the amount of glycerinated lymph contained in a capillary tube) of lymph pulp which are capable of growing upon bouillon agar.

The dilution plates, the colonies in which, being much fewer in number, have been able to develop their characteristic forms and colours, are, after this further incubation at 18-20° C., dealt with as follows: The colonies are carefully scrutinised, microscopical specimens are made and stained, and the growths transferred in subculture to various media, until the identity of the several micro-organisms is established.

In similar way also, the same glycerinated lymph pulp during its period of keeping in the Laboratories is tested week by week, and the gradual extermination of the contained micro-organisms and their relative rate of disappearance is duly noted.

Below is a table showing the varieties of micro-organisms found in the 500 lymph emulsions examined in the above way. The organisms are arranged in order of frequency of occurrence, and the number of separate lymphs in which each was found is

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On Bacteria in Glycerinated Calf Lymph; by Mr. Fremlin.

noted. The actual numbers, however, must be looked upon as only approximate, since an exhaustive examination of each colony was impossible.

TABLE of extraneous organisms found in lymph pulp, arranged in order of frequency of occurrence.

Name of Organism.	Number of times found.
1. Staphylococcus Pyogenes Aureus	500
2. Staphylococcus Pyogenes Albus	484
3. Bacillus (not named)	370
4. Staphylococcus Cereus Albus	300
5. Streptothrix Alba	50
6. Hay bacilli	31
7. Sarcina Lutea	22
8. Staphylococcus Pyogenes Citreus	7
9. Staphylococcus Cereus Flavus	6
10. Penicillium Glaucum	4
11. Proteus Vulgaris	2
12. B. Fluorescens Liquefaciens	1

STAPHYLOCOCCUS PYOGENES AUREUS.

This is always present in our lymph pulp. It usually predominates over all other extraneous micro-organisms.

The colonies of S. pyogenes aureus vary greatly in colour. As a rule they are orange, but all gradations of shading occur from deep orange to white. Buff and cream coloured colonies are fairly frequent, and it is usually among the latter that the white colonies are noticed. These white colonies, as seen on a plate, much resemble S. pyogenes albus, but if they are transferred to sloping agar the growth usually becomes cream coloured; and this growth transferred in turn to gelatine shows liquefaction along the line of inoculation, and an orange precipitate collects below. This precipitate is a characteristic growth of S. pyogenes aureus. If the growth is sub-cultured from agar to potato, and grown at room temperature, the orange colour is usually well developed.

In this connection it will be remembered that in ordinary cultivations of S. pyogenes aureus grown at 37° C., large colonies appear in 24 hours, which at this stage are indistinguishable from S. pyogenes albus; a few hours later a faint tinge of cream colour is seen, but it is only after 48 hours at 37° C. that the colonies have acquired their characteristic colour. I hope to be able to make further experiments later with regard to the development of the pigment. Another interesting fact noted in some colonies is the juxtaposition of this organism with S. pyogenes albus in one and the same colony. One may see a colony that has an orange centre and a white margin, or one that is half orange and half white, or one that has a sector, one-fourth or less, white in colour, the remainder of the colony being orange. Proof of the nature of this combination was obtained by inoculating from the different coloured portions and subculturing in the usual way, when the colonies were found to be due to S. pyogenes aureus on the one hand, and S. pyogenes albus on the other.

STAPHYLOCOCCUS PYOGENES ALBUS (of ROSENBACH).

This micro-organism occurs in nearly all the lymphs that I have examined. Out of 500 lymphs tested its presence has been noted in all but 16. On six occasions it has been the commonest species present. Its colonies have a greyish white look, and it rapidly liquefies gelatine.

BACILLUS (not named).

This micro-organism is of frequent occurrence in lymph pulp. It had never been observed in the plate cultivations before February, 1899, and it is practically certain that before that date it was not present in any of the lymphs collected. Its appearance synchronized with the use for a series of calves of a particular stock of German lymph; but since it has occurred in almost every lymph pulp, both from calves connected with this series and calves not so connected.

The following is a general description of this bacillus:—

The micro-organism is a non-motile bacillus varying in length from 2—4 μ.; it is protean in form, many being rod-shaped, others pyriform. No spores have been observed. It is very resistant to the action of glycerine, and colonies of this micro-organism have been noted in glycerinated pulp after seven weeks. It grows well at 37° C., but no growth has been observed at 20° C. It stains with the usual reagents, but not by Gram's method.

On Cultivation.

Agar plates.—Two forms of colonies are seen:—

1. Large colonies 4—8 mm. in diameter, irregular in outline, very thin and semitransparent, and dull white in colour.
2. Large colonies, of the same size as the 1st form, and having like those an irregular outline, but differing in being of a white or pale cream colour, thick, and opaque; they have, like the 1st form, a dull appearance.

Colonies of this bacillus are readily distinguished from those of the staphylococci, their dull appearance contrasting markedly with the polished surface of the latter. Under the A.A. objective of the microscope the colonies appear brown in colour, and have a markedly granular appearance.

Sloping agar.—The growth spreads over the whole surface, is whitish in colour, and has a dull and somewhat granular appearance.

Blood Serum.—The micro-organism gives a good growth. General appearance much the same as that on agar, but the growth is more confined to the line of inoculation.

Gelatine.—The micro-organism does not grow at all satisfactorily below 26° C. Tubes kept at 37° C. for ten days became solid on cooling, showing that this organism does not liquefy the medium. At 37° C., however, the bacillus appears to grow well in this medium, as a quantity of white precipitate is to be seen at the bottom of the liquid gelatine.

Potato.—It does not grow well on this medium. A scanty growth appears, of a pale ochre colour.

Milk.—It causes no souring or curdling of milk.

Sugar agar.—The micro-organism grows fairly well, but has no fermentative action on the sugar.

This micro-organism is of interest, as showing many points of resemblance to an organism recently described by Dr. Nakanishi in the Centralblatt of May 29th, 1900, and there called the Bacillus variabilis lymphæ vaccinalis. This organism, he finds, does not produce vesicles on calves, but yet he is inclined to ascribe to it the role of specificity. Dr. Nakanishi considers that his bacillus is a variety of Klein's Bacillus xerosis variolæ and of Klein's Bacillus albus variolæ.

STAPHYLOCOCCUS CEREUS ALBUS (OF PASSET).

This micro-organism occurs frequently in lymph, but is not so numerous as S. pyogenes albus. It does not liquefy gelatine.

STREPTOTHRIX ALBA.

This micro-organism is not seldom found in plate cultivations. It grows slowly, and is not usually observed before the eighth day. As a rule, not more than one colony is found on a plate.

HAY BACILLI.

This group of micro-organisms is exceedingly abundant everywhere, and it is, therefore, very difficult to exclude them entirely from lymph. They are practically never found in cultivations of lymph made on the occasion of emulsifying with glycerine, but are seen sometimes in plates made at the end of the first, second, and third weeks. Here they may be the result of an accidental contamination, but they may also have been present from the beginning, the number of other extraneous micro-organisms growing on the plates of lymph examined at the time of emulsifying with glycerine having then prevented their growth. The colonies are never numerous, only one or two being found as a rule. I have noted the following species belonging to this group :—

Bacillus Subtilis.
Bacillus Mesentericus Vulgatus.
Bacillus Mesentericus Fuscus.
Bacillus Mesentericus Ruber.

None of the above bacilli are pathogenic, and with care in collecting and storing lymph, their numbers can be reduced to a minimum.

SARCINA LUTEA.

This micro-organism occurs occasionally, but the colonies are never numerous.

STAPHYLOCOCCUS PYOGENES CITREUS (OF ROSENBACH).

This only occurs occasionally, and usually not more than one colony is found on a plate.

STAPHYLOCOCCUS CEREUS FLAVUS.

This micro-organism only occurs occasionally, single colonies being seen at times on a plate.

PENICILLIUM GLAUCUM.

This has occured on four occasions. In two series it was very numerous.

PROTEUS VULGARIS.

This micro-organism has only been found in lymph pulp on two occasions. It rapidly disappears under the influence of glycerine.

BACILLUS FLUORESCENS LIQUEFACIENS.

This bacillus has only once been found in the lymph. It was probably derived from the water.

App. B, No. 10.

On Bacteria in Glycerinated Calf Lymph; by Mr. Fremlin.

In conjunction with the examination of lymph, I have also done some work on the bacteria occurring in the calf stables.

Cultures were made from the surface of the skin of a calf which was ready for vaccinating. The skin is prepared by shaving off the hair and afterwards by washing the shaved surface first with water, next with 5 per cent. of carbolic acid, and then with sterile water; the surface being finally dried by aseptic gauze sponges. The skin being thus in a condition to vaccinate, I tested the sterility of the surface by rubbing it with a sterile platinum needle. The needle so treated was rubbed on to surface agar to note any growth occurring. It was found that no growth occurred.

Cultures were also taken from the surface of the skin of a calf between the lines of the vesicles at a time when the vesicles were matured, and after the vaccinated area of the calf had been thoroughly cleansed in readiness for collection. From the inoculated surface agar growth of S. pyogenes aureus and S. pyogenes albus was obtained.

Bacteriological examination of hay collected from the calf stables yielded a pure culture of B. subtilis.

Straw from the loft was found to contain B. mesentericus and S. pyogenes aureus. Straw taken from the calf stalls yielded B. subtilis, S. pyogenes aureus, and a mould.

Calf fæces were also examined, but no organisms were found corresponding to those obtained from lymph pulp.

From the observations so far made, I find that freshly-made glycerine emulsion of lymph pulp averages, when inoculated into agar plates, 123,000 colonies per loopful. If the number of colonies exceed this very largely, there is suggestion that the lymph is not of first class quality. The reason for this is as follows. On a vaccinated calf, vesicles which are not quite perfect in form have a crusty appearance, due to dead epithelium and dried exudation. This material affords harbourage for an enormous number of extraneous micro-organisms, which being necessarily collected with the contents of the vesicles, yield an excessive number of colonies when examination is made of the lymph pulp in fresh glycerine emulsion. Thus a number of lymphs of indifferent quality averaged at glycerination 234,000 colonies per loopful on agar plates.

The EFFECT of GLYCERINE.

In the plates established at one week, two weeks, three weeks, and four weeks after the preparation of the glycerine emulsion the effect of glycerine in inhibiting and eliminating the extraneous organisms is very marked. Its primary effect is that of inhibition of the growth of the micro-organisms. Generally, plates seen at the second week of glycerination exhibit very tiny colonies.

APP. B, No. 10.

On Bacteria in Glycerinated Calf Lymph: by Mr. Fremlin.

As a rule a fresh glycerine emulsion which on plate cultivation shows 120,000 colonies will, one week after, show an average of 700 colonies per loopful.

Two weeks after, an average of 50 colonies per loopful.

Three weeks after, an average of 10 colonies per loopful.

Four weeks after, there are usually no colonies noted in one loopful.

All the micro-organisms are not acted upon in the same degree; the effect of glycerine varies with the species.

S. pyogenes albus usually disappears by about the third week at 20° C.

S. pyogenes aureus is in great measure destroyed at the same time, but a few colonies can be found in the fourth week.

The *bacillus* that I have described, but have not yet been able to name, is very persistent. The number of its colonies which appear on the plates is much reduced at the end of the fourth week, but some colonies may be found many weeks after the pulp has been glycerinated.

Penicillium Glaucum.—This micro-organism spores very readily, and these spores do not appear to be destroyed by the glycerine.

Group of hay Bacilli.—These micro-organisms spore very freely, and their spores are very resistant; hence glycerine has little effect on them when they occur.

In this bacteriological work practically the only medium employed has been bouillon agar. Further experiments with other media are in progress, and also experiments are being devised to ascertain if lymph pulp as such contains any anaërobic micro-organisms and if so, what is their nature. These matters will be dealt with in a further report.

PSEUDO-TUBERCULOSIS.

PLATE I.

FIG. I.

Liver and spleen of a guinea-pig that had been infected with bacillus pseudo-tuberculosis by subcutaneous inoculation. Both the liver and the spleen are permeated by and beset with small white nodules.

[Natural size.]

PLATE I.

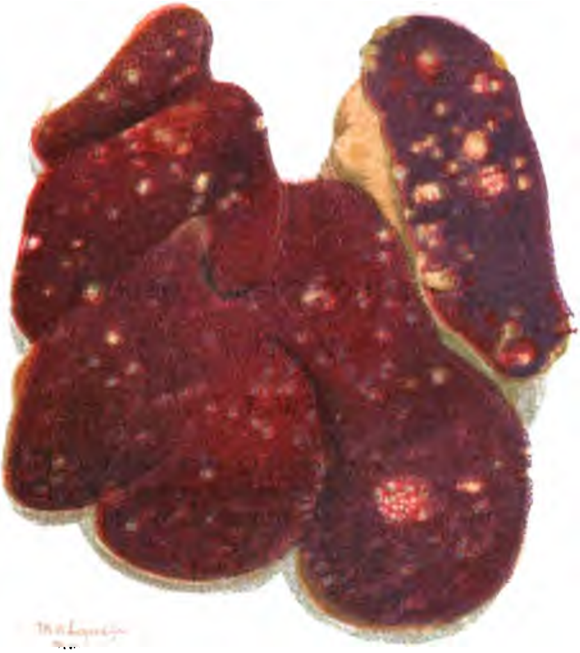

Fig. I.

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PLATE II.

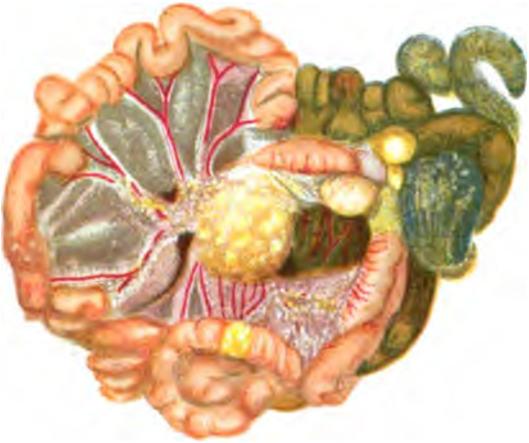

Fig. 2.

Fig. 4.

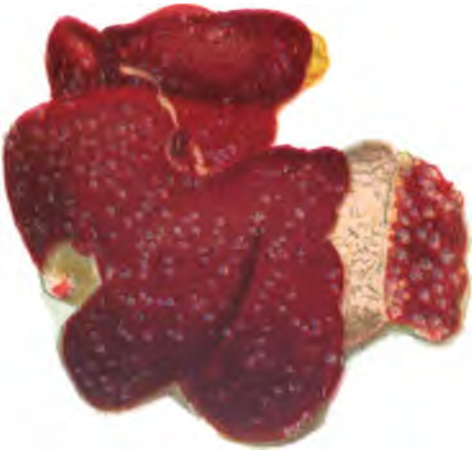

Fig 3.

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PSEUDO-TUBERCULOSIS.

PLATE II.

FIG. 2.

From a guinea-pig infected with pseudo-tuberculosis by feeding with culture of bacillus pseudo-tuberculosis. The illustration shows (*a*) loops of the ileum (pink) several small white nodules are seen in the wall of the intestine, one large caseous nodule is present in the lower portion; (*b*) at the ileo-cœcal valve (right upper corner of the pink part) several caseous nodules; (*c*) the mesenteric glands (middle of the figure) are greatly enlarged and show numerous caseous nodules; (*d*) the (white) chyle vessels passing from the intestine to the mesenteric glands show numerous small white nodules.

[Natural size.]

FIG. 3.

Liver and spleen of the same guinea-pig as shown in Fig. 2.

[Natural size.]

FIG. 4.

Culture of bacillus pseudo-tuberculosis on potato in a test tube. The growth is a circular brownish patch with lighter knobbed margin.

[Natural size.]

PSEUDO-TUBERCULOSIS.

PLATE III.

Fig. 5.

From the liver of a rabbit, intravenously injected with culture of bacillus pseudo-tuberculosis. The section is through blood vessels distended by emboli consisting of bacilli.

[Magnifying power, 250.]

Fig. 6.

From the same liver as shown in Fig. 5, more highly magnified; the bacilli forming the emboli plugging the vessels are here well seen.

[Magnifying power, 1,000.]

PLATE III.

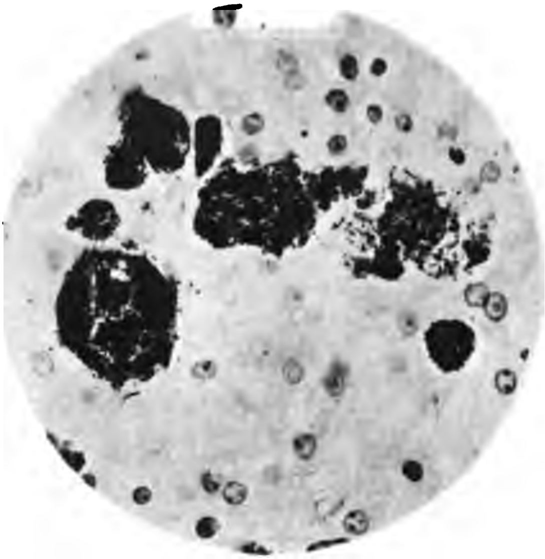

FIG. 5.

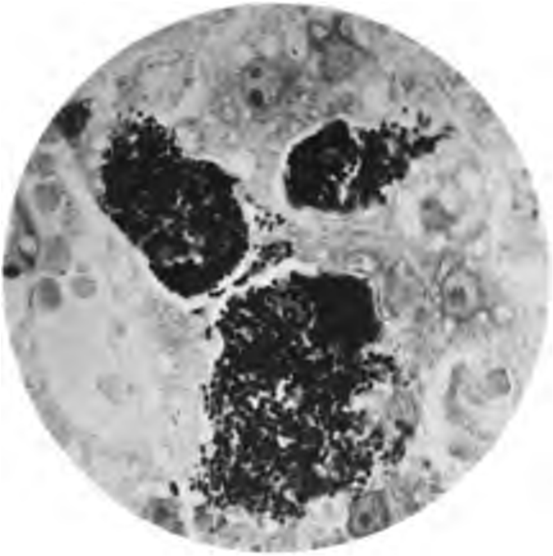

FIG. 6

PLATE IV.

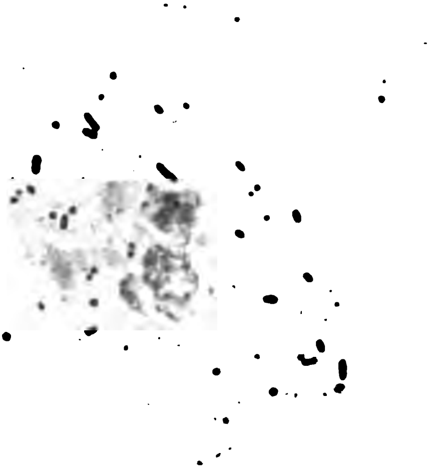

FIG. 7.

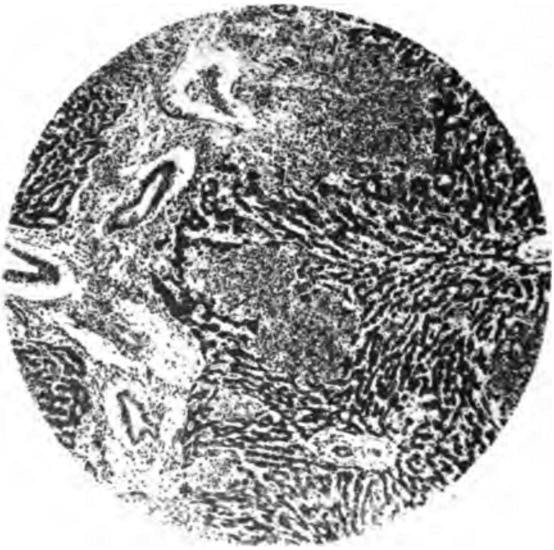

FIG. 8.

PSEUDO-TUBERCULOSIS.

PLATE IV.

FIG. 7.

From a necrotic nodule of the spleen of a monkey that had been injected subcutaneously with culture of the bacillus pseudotuberculosis; showing numerous isolated bacilli in the necrotic tissue.

[Magnifying power, 1,000.]

FIG. 8.

Section through the liver of a guinea-pig dead after subcutaneous injection with culture of the bacillus pseudo-tuberculosis. On the left part of the figure is a strand of the interlobular tissue (vessels and bile ducts) infiltrated with round cells, nodular masses of such cells invade the liver tissue of the lobules, the trabeculæ of the liver cells are seen darkly stained. There is no necrotic change as yet.

[Magnifying power, 70.]

PSEUDO-TUBERCULOSIS.

PLATE V.

FIG. 9.

From a section through the liver of a guinea-pig dead after subcutaneous injection with bacillus pseudo-tuberculosis. The liver was pervaded by nodules, some in the early stage (round cell masses), others already necrotized, near the surface of the liver (upper part of the figure), one such necrotic mass is shown, in which large and small aggregations (deeply stained masses) of the bacilli are recognisable.

[Magnifying power, 50.]

FIG. 10.

From a section of a similar liver, showing the liver tissue pervaded by the nodules.

[Magnifying power, 23.]

PLATE V.

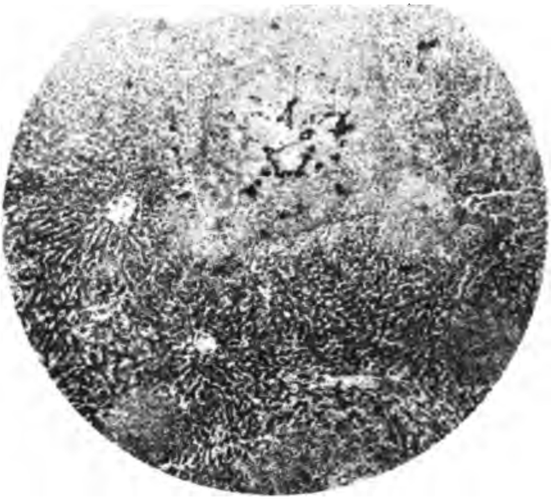

FIG. 9.

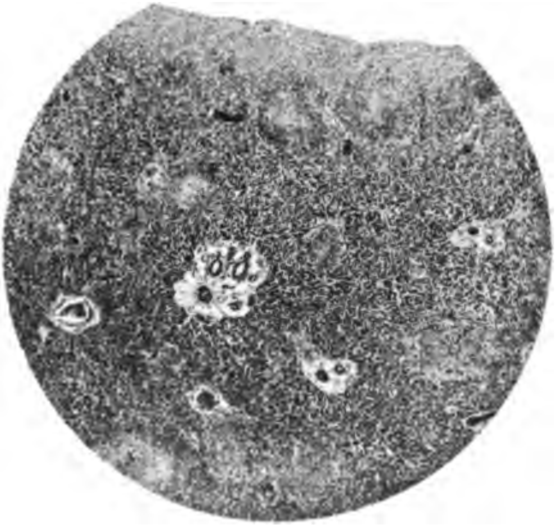

FIG. 10.

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PLATE VI.

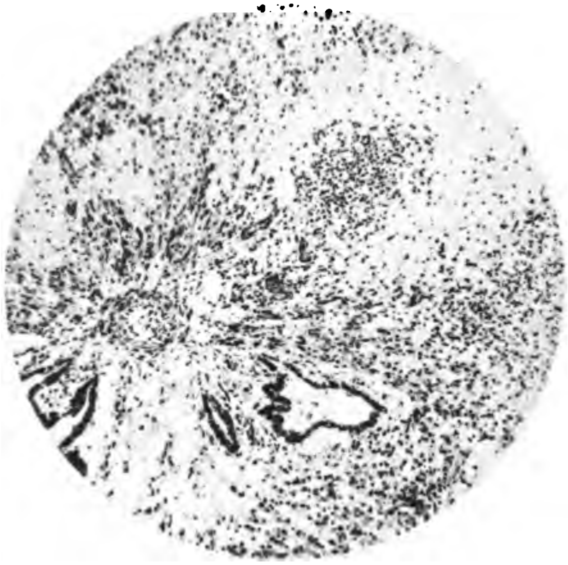

FIG. 11.

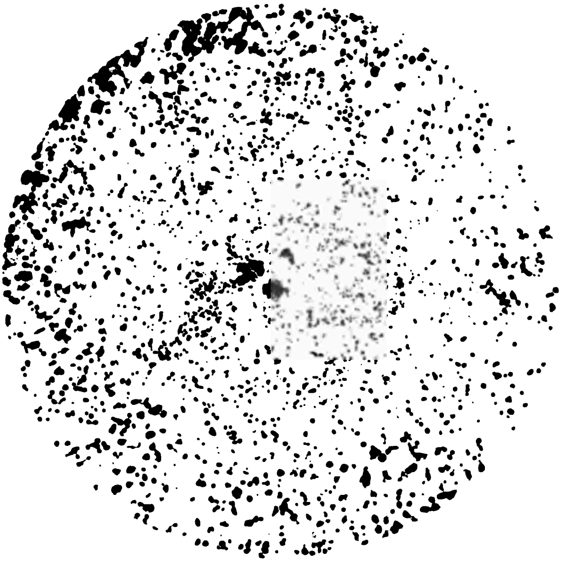

FIG. 12.

PSEUDO-TUBERCULOSIS.

PLATE VI.

FIG. 11.

From a section of a liver of guinea-pig in advanced state of pseudo-tuberculosis, showing extensive necrosis of the tissue—the masses which are not stained.

[Magnifying power, 85.]

FIG. 12.

The centre of a necrotic nodule in the liver; very little of the liver tissue is left, in the centre a few clumps of the bacilli (deeply stained).

[Magnifying power, 85.]

PSEUDO-TUBERCULOSIS.

PLATE VII.

FIG. 13.

The central part of a necrotic nodule of the liver of a guinea-pig dead after subcutaneous injection with culture of the bacillus pseudo-tuberculosis, showing in the necrotic (non-stainable) tissue large and small aggregations of the bacilli.

[Magnifying power, 250.]

FIG. 14

Section through a nodule of the lung of a guinea-pig dead after subcutaneous injection with culture of the bacillus pseudo-tuberculosis. The nodule consists of the air-cells and infundibula filled with and distended by exudation, in which masses of (deeply stained) bacilli are present.

[Magnifying power, 85.]

FIG. 15.

Masses of chains of the bacilli on the outer portion of a nodule of the lung of same preparation as in Fig. 14.

[Magnifying power, 1,000.]

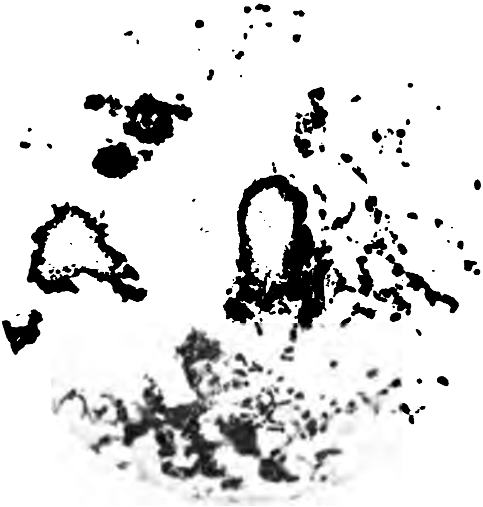

FIG. 13.

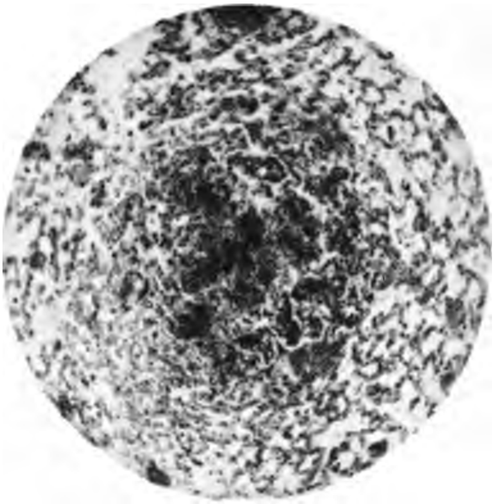

FIG. 14.

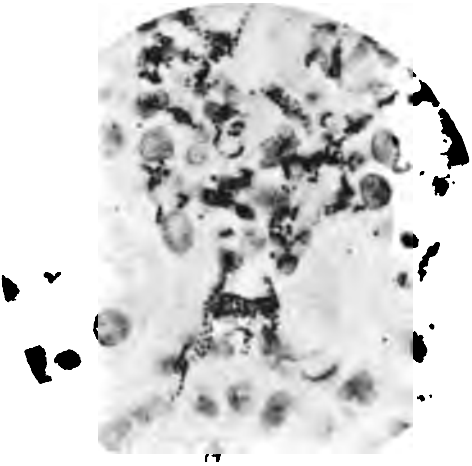

FIG. 15

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TILDEN FOUNDATIONS

PLATE VIII.

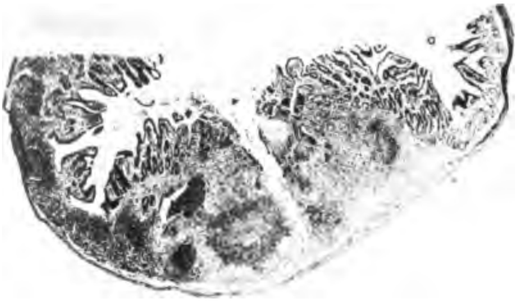

FIG. 16.

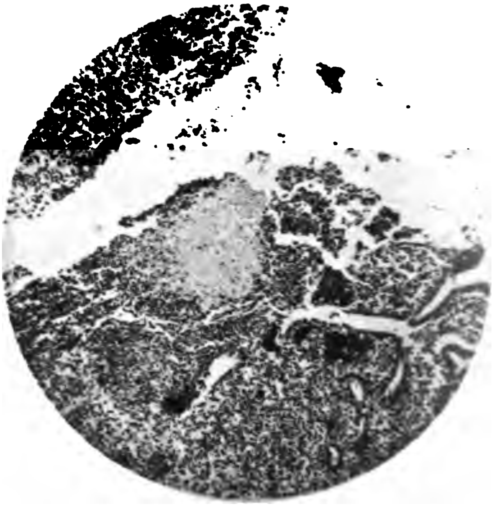

FIG. 17.

FIG. 18

PSEUDO-TUBERCULOSIS.

PLATE VIII.

FIG. 16.

Section through a swollen Peyer's patch of the ileum of a guinea-pig infected by feeding with culture of bacillus pseudotuberculosis. The lymph follicles of the Peyer's patch are enlarged and necrotic.

[Magnifying power, 18.]

FIG. 17.

A portion of necrotic lymph-follicle of a similar Peyer's patch as preceding figure, more magnified, showing deeply stained masses of the bacilli around it.

[Magnifying power, 65.]

FIG. 18.

Film specimen of purulent caseous matter of inguinal lymph gland of a guinea-pig dead of pseudo-tuberculosis after injection into the groin. Leucocytes swollen and disintegrating, containing the bacilli.

[Magnifying power, 1,000.]

PSEUDO-TUBERCULOSIS.

PLATE IX.

FIG. 19.

Similar film specimen as in preceding figure; the bacilli are chiefly within the substance of the swollen leucocytes, of which the nuclei are deeply stained.

[Magnifying power, 1,000.]

FIG. 20.

From the caseous matter of a nodule of the pancreas; one swollen leucocyte with two deeply stained nuclei; in the substance of the swollen leucocyte numerous bacilli.

[Magnifying power, 1,000.]

FIG. 21.

Film specimen of the caseous matter of the nodules of the pancreas of a guinea-pig dead of pseudo-tuberculosis, showing continuous masses of swollen and disintegrating leucocytes (nuclei deeply stained) containing in their protoplasm masses of the bacilli.

[Magnifying power, 1,000.]

PLATE IX.

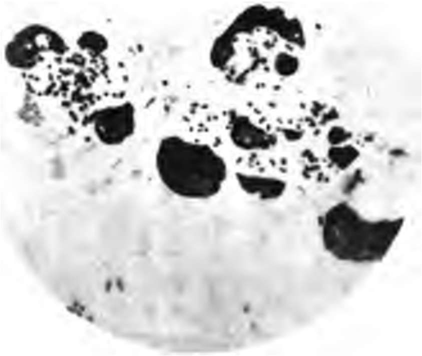

FIG. 19.

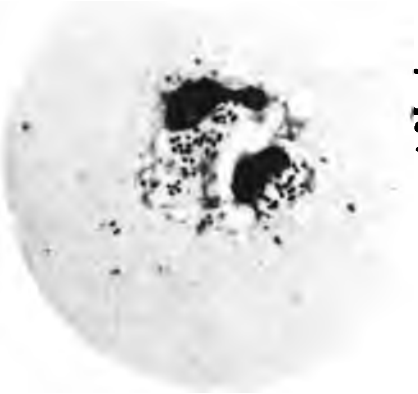

FIG. 20.

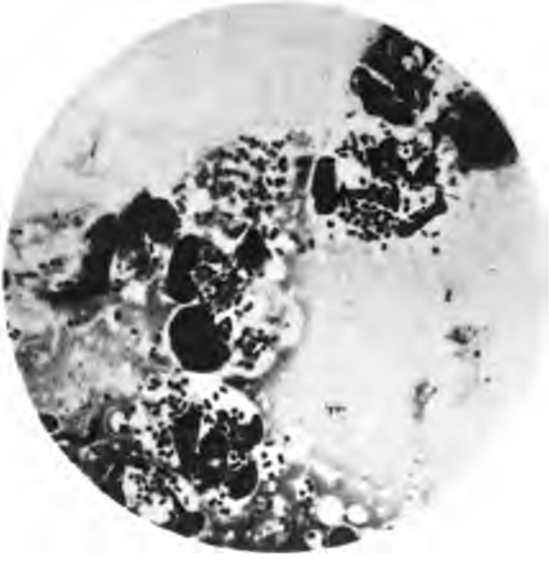

FIG. 21.

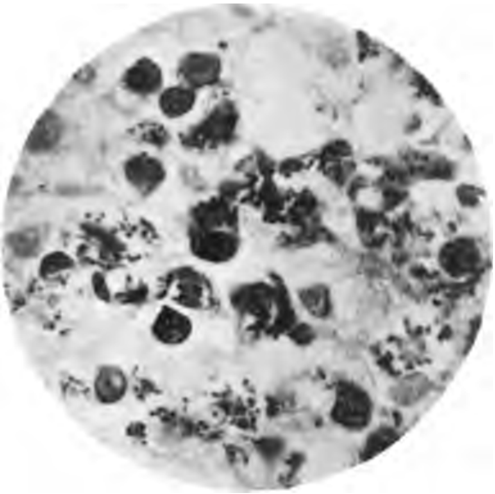

FIG. 22.

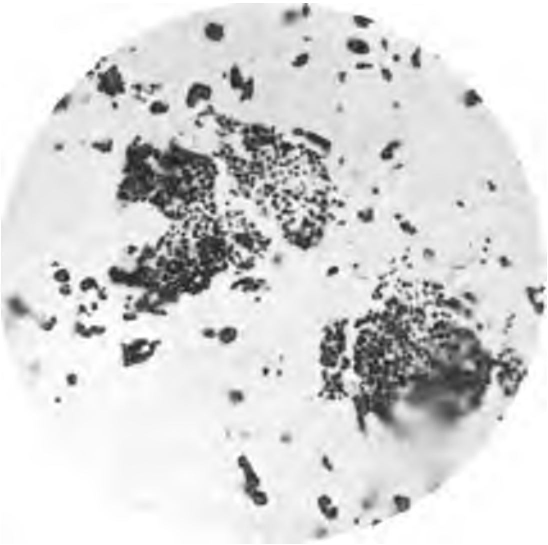

FIG. 23.

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PSEUDO-TUBERCULOSIS.

PLATE X.

FIG. 22.

From a section through a young nodule in the pancreas, showing masses of the bacilli contained within leucocytes.

[Magnifying power, 1,000].

FIG. 23.

From a section through a necrotic nodule of the liver; showing aggregations of the bacilli in the necrotic (unstainable) tissue.

[Magnifying power, 1,000.]

PSEUDO-TUBERCULOSIS.

PLATE XI.

FIG. 24.

A trace of the pus of the necrotic inguinal gland rubbed over the slanting surface of gelatine, incubated for several days at 20° C. Numerous colonies of the bacillus pseudo-tuberculosis in pure culture.

[Natural size.]

FIG. 25.

Gelatine surface, which had been inoculated with a drop of blood of a guinea-pig dead of pseudo-tuberculosis. Several days incubation at 20° C.

[Natural size.]

FIG. 26.

Gelatine surface plate; over the surface of the set gelatine, a drop of the pus of the pseudo-tuberculosis inguinal gland had been rubbed; incubated for three days at 20° C. The plate is a pure culture of colonies of the bacillus pseudo-tuberculosis.

[Magnifying power, 5.]

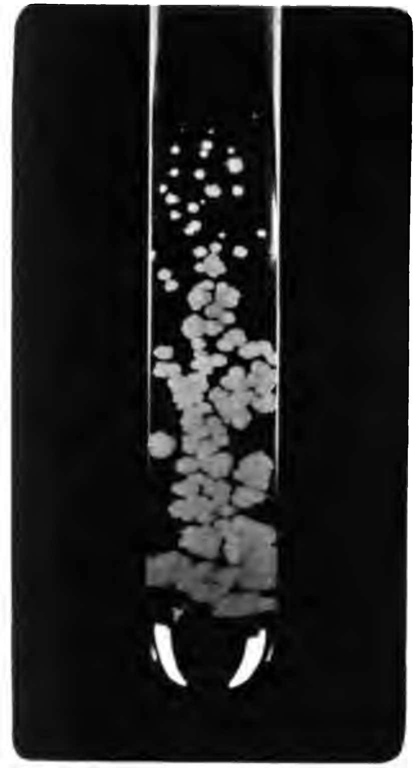

FIG. 24.

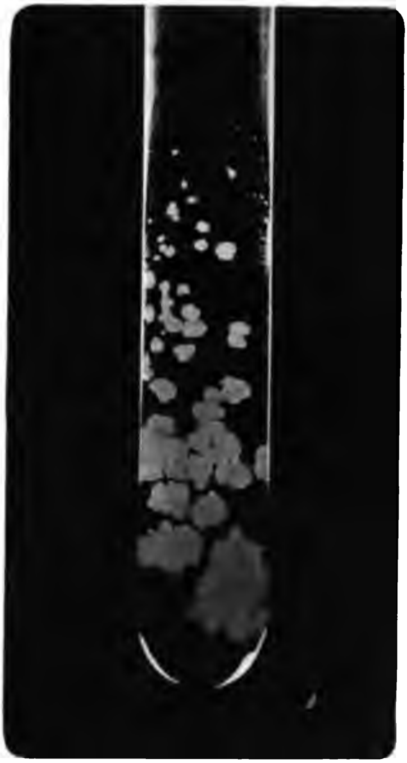

FIG. 25.

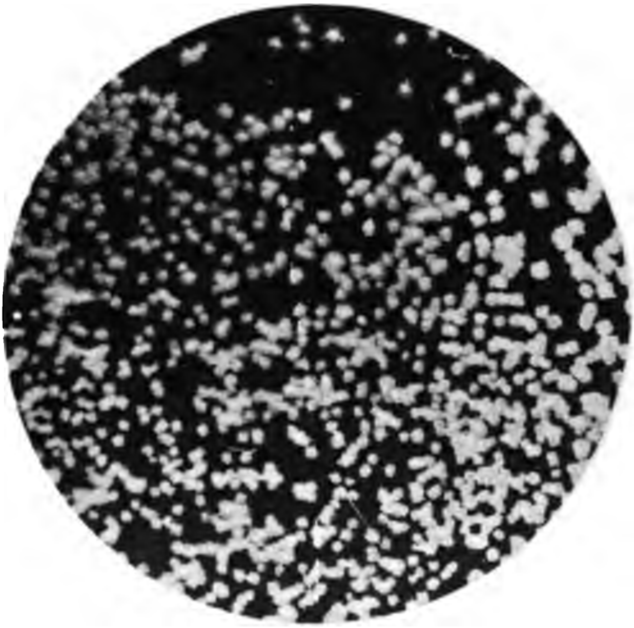

FIG. 26

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PLATE XII.

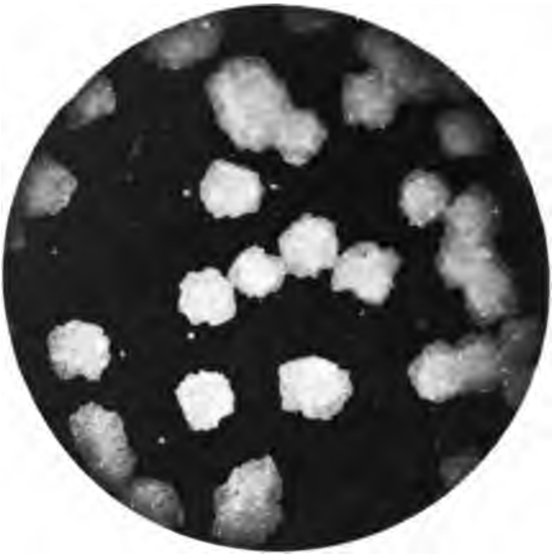

FIG. 27.

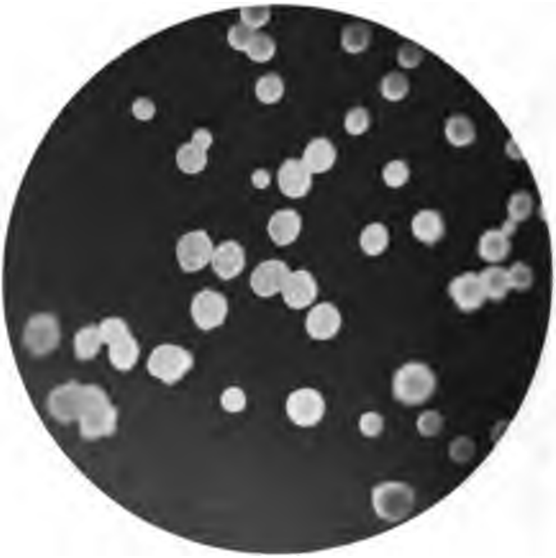

FIG. 28.

PSEUDO-TUBERCULOSIS.

PLATE XII.

Fig. 27.

A portion of same gelatine surface plate.

[Magnifying power, 18.]

Fig. 28.

Surface agar plate, from same material as Fig. 26. Incubated for 40 hours at 37° C.

[Magnifying power, 5.]

PSEUDO-TUBERCULOSIS.

PLATE XIII.

FIG. 29.

Streak culture on gelatine surface of bacillus pseudo-tuberculosis, several days incubation at 20° C.

[Natural size.]

FIG. 30.

Stab culture in gelatine of bacillus pseudo-tuberculosis, several days incubation at 20° C.

[Natural size.]

FIG. 31.

Upper part of same stab culture.

[Magnifying power, 4.]

PLATE XIII.

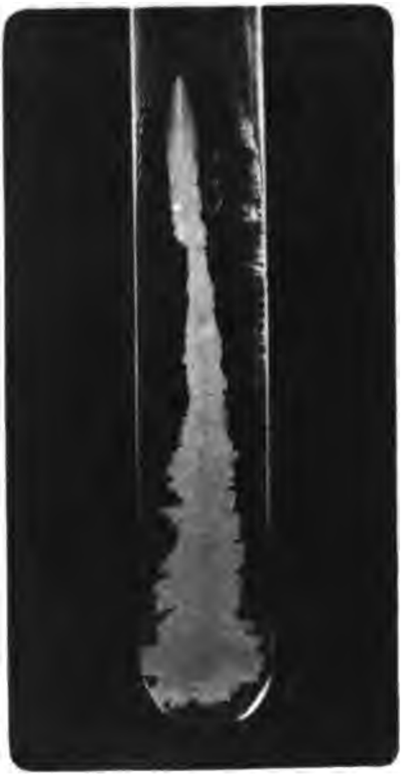

FIG. 29.

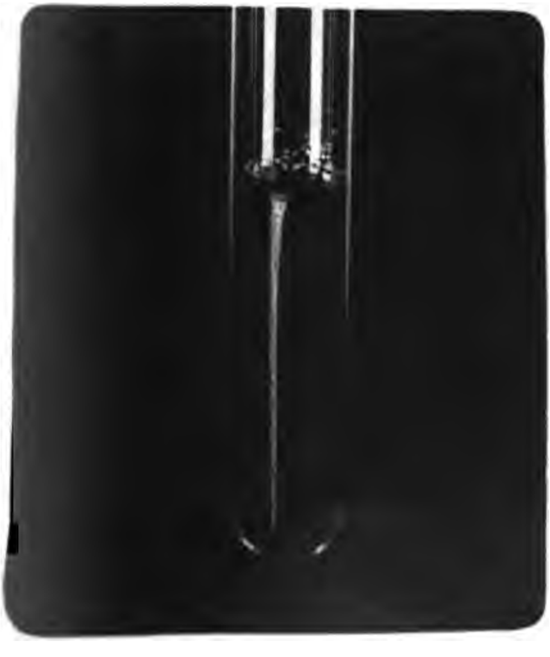

FIG. 30.

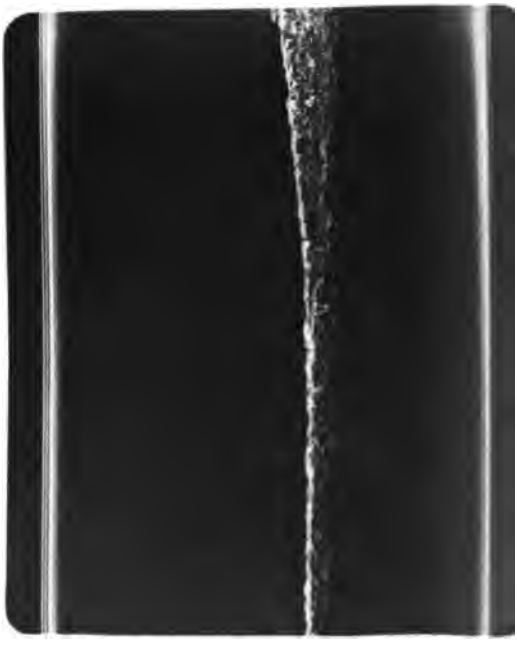

FIG. 31.

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PLATE XIV.

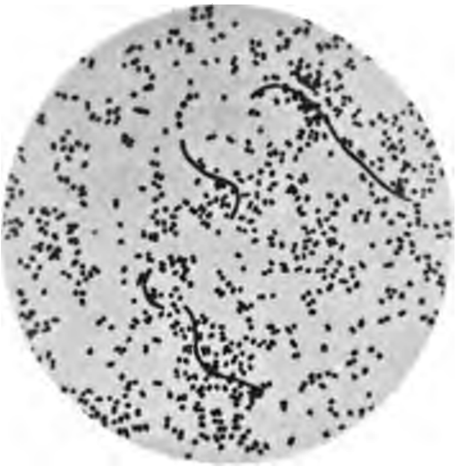

FIG. 32.

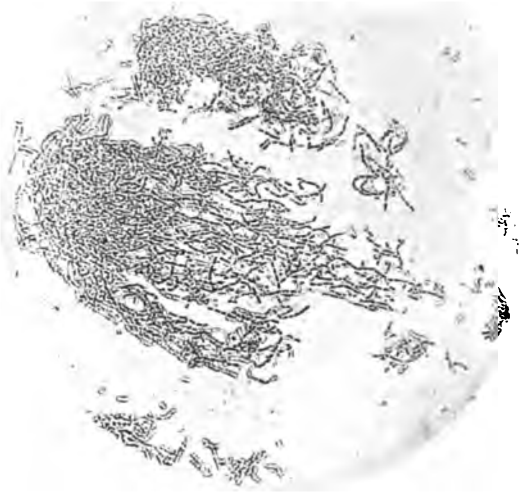

FIG. 33.

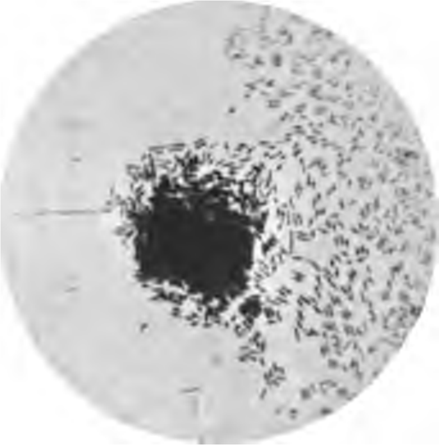

FIG. 34.

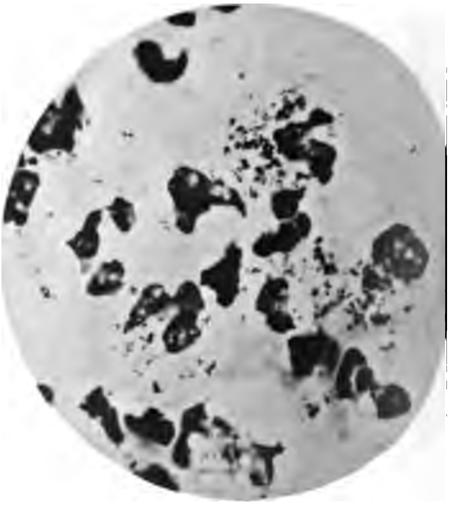

FIG. 35.

PSEUDO-TUBERCULOSIS.

PLATE XIV.

FIG. 32.

Film specimen (stained) of bacillus pseudo-tuberculosis. from Agar colonies 24 hours old.

[Magnifying power, 1,000.]

FIG. 33.

From an unstained broth culture of bacillus pseudo-tuberculosis, incubated 24 hours at 37° C.; showing a "granule" or flocculus composed of chains of the bacilli.

[Magnifying power, 400.]

FIG. 34.

From an impression (film) specimen of a young colony on a gelatine plate of bacillus pseudo-tuberculosis.

[Magnifying power, 1,000.]

FIG. 35.

Film specimen of inguinal purulent matter of a guinea-pig injected subcutaneously with bacillus pyogenes cloacinus; numerous bacilli in the substance of the pus cells.

[Magnifying power, 1,000.]

PSEUDO-TUBERCULOSIS.

PLATE XV.

FIG. 36.

Film specimen of peritoneal pus of a guinea-pig injected intraperitoneally with the bacillus pyogenes, showing crowds of the bacilli within the swollen and disintegrating leucocytes.

[Magnifying power, 1,000.]

FIG. 37.

Film specimen of same peritoneal purulent matter as in preceding figure.

[Magnifying power, 1,000.]

FIG. 38.

Film specimen of pericardial purulent matter of a guinea-pig dead after injection with bacillus pyogenes, showing masses of the bacilli in swollen and disintegrating leucocytes.

[Magnifying power, 1,000.]

FIG. 39.

Film specimen of purulent matter of pleural cavity of same animal as in Fig. 38. The intracellular presence of the bacilli is well shown.

[Magnifying power, 1,000.]

PLATE XV.

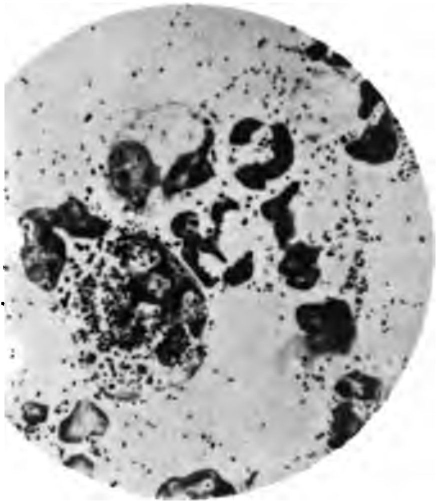

FIG. 36.

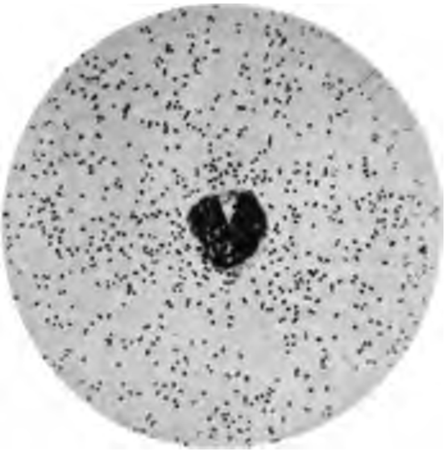

FIG. 37.

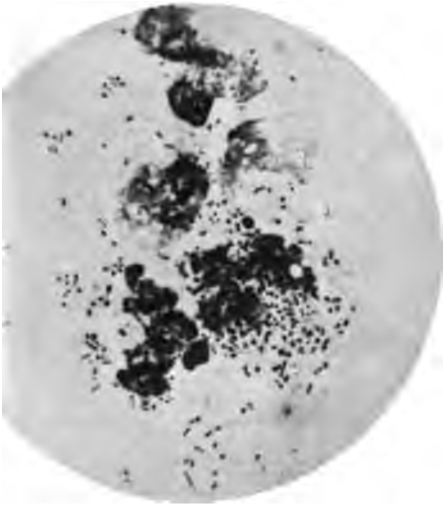

FIG. 38.

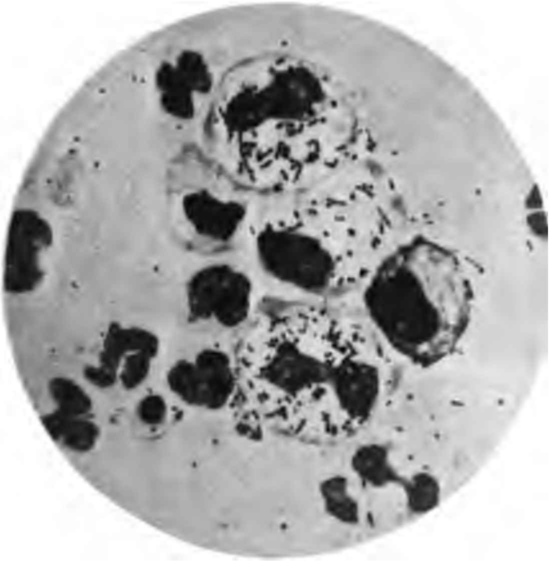

FIG. 39.

PLATE XVI.

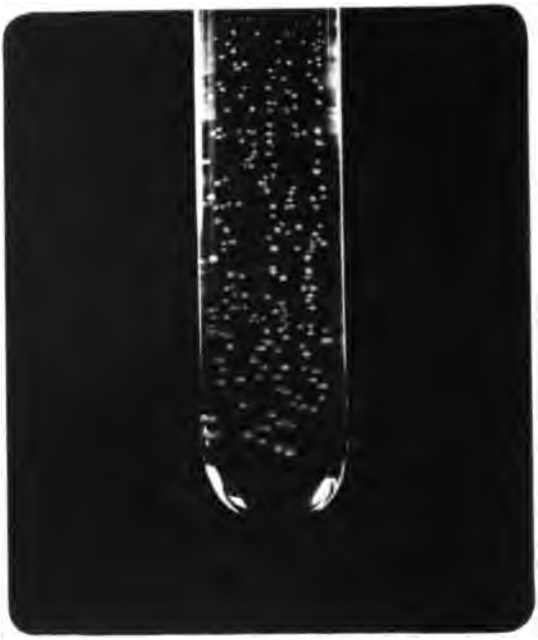

FIG. 40.

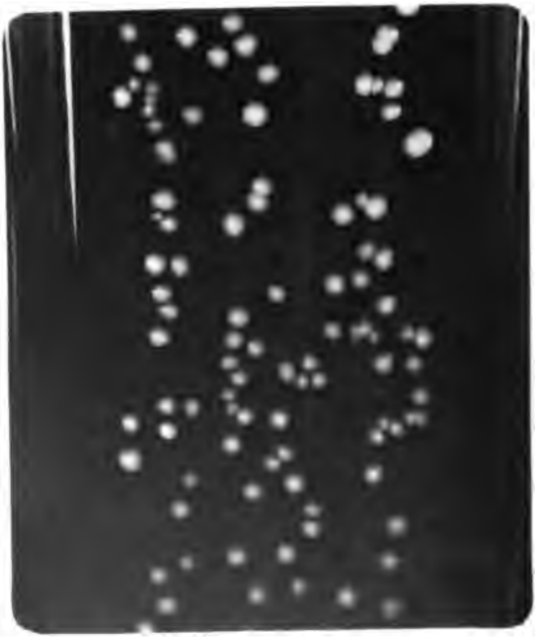

FIG. 41.

PSEUDO-TUBERCULOSIS.

PLATE XVI.

FIG. 40.

Slanting surface of gelatine that had been inoculated with a trace of the peritoneal purulent exudation after great dilution; showing numerous colonies in pure culture of the bacillus pyogenes. Incubation at 20° C. for several days.

[Natural size.]

FIG. 41.

Part of above culture.

[Magnifying power, 3½.]

PSEUDO-TUBERCULOSIS.

PLATE XVII.

FIG. 42.

Colonies of the bacillus pyogenes on agar surface after several days incubation at 37° C.

[Magnifying power, 6.]

FIG. 43.

Streak culture on gelatine of bacillus pyogenes after a week's incubation at 20° C.; the growth in the streak only is here shown.

[Magnifying power, 10.]

FIG. 44.

From a stab culture in gelatine of bacillus pyogenes, showing the stab growth composed of minute droplets. Several days incubation.

[Magnifying power, 10.]

FIG. 45.

Impression (stained) specimen of a young colony on gelatine of bacillus pyogenes.

[Magnifying power, 1,000.]

PLATE XVII.

FIG. 42.

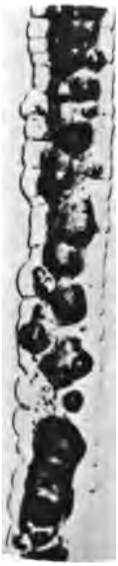

FIG. 43.

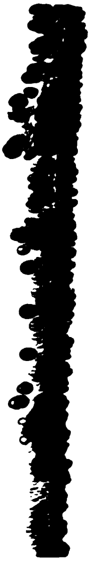

FIG 44.

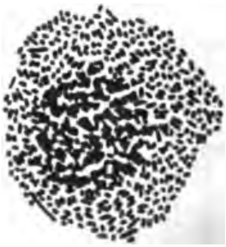

FIG. 45.

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PLATE XVIII.

FIG. 46.

FIG. 47.

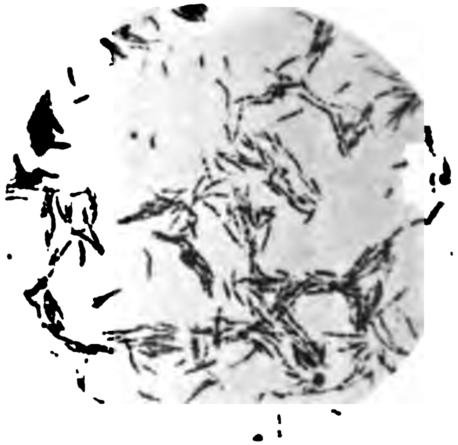

FIG. 48.

PATHOGENIC MICROBES IN MILK, CREAM, AND CHEESE.

PLATE XVIII.

FIG. 46.

Impression preparation of colonies of tubercle bacilli, the colonies were growing on the surface of solidified blood serum that had been inoculated from a milk culture of tubercle bacilli.

[Magnifying power, 85.]

FIG. 47.

Impression preparation of same culture as in Fig. 46.

[Magnifying power, 125.]

FIG. 48.

Strands of actively growing tubercle bacilli from a milk culture.

[Magnifying power, 1,000.]

PATHOGENIC MICROBES IN MILK, CREAM, AND CHEESE.

PLATE XIX.

FIG. 49.

Strands of actively growing tubercle bacilli from a recent serum culture, showing acid fast (pink) and acid weak (blue) bacilli.

[Magnifying power, 1,000.]

PLATE XIX.

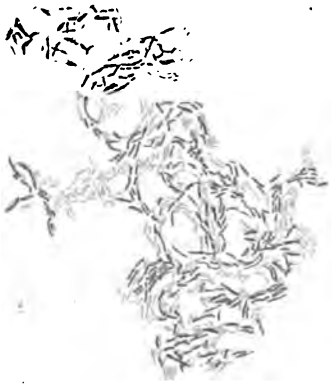

Fig. 49.

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TILDEN FOUNDATIONS.

FIG. 1.

FIG. 2.

STREPTOCOCCUS SCARLATINÆ.

PLATE XX.

FIG. 1.

Streptococcus scarlatinæ, or conglomeratus, No. 35. Broth, 1 day, showing conglomerate masses of the growth.

[Magnifying power, 18.]

FIG. 2.

The same, crushed out between two cover-glasses, showing resistance to separation.

[Magnifying power, 500.]

STREPTOCOCCUS SCARLATINÆ.

PLATE XXI.

FIG. 3.

Streptococcus scarlatinæ, No. 55. Broth, 1 day, showing conglomerate streptococcus.

[Magnifying power, 1,000.]

FIG. 4.

The same organism. Agar, 1 day, showing prominent bacillus formation.

[Magnifying power, 1,000.]

FIG. 5.

The same organism. Gelatine, 3rd day, showing bacillary forms in the colonies.

[Magnifying power, 1,000.]

FIG. 6.

The same organism. Blood serum condensation fluid, 1 day. showing streptococcus chains.

[Magnifying power, 1,000.]

PLATE XXI.

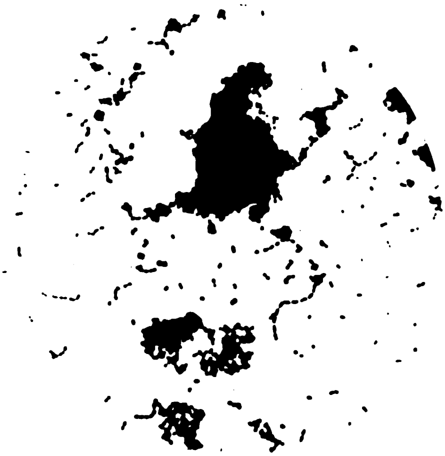

FIG. 3.

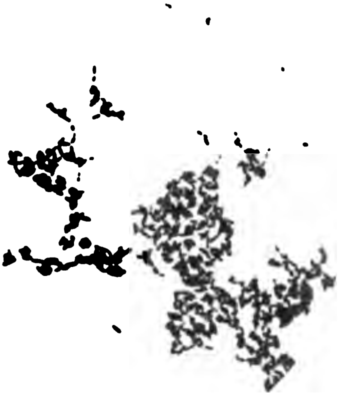

FIG. 4.

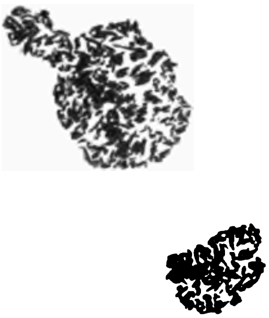

FIG. 5.

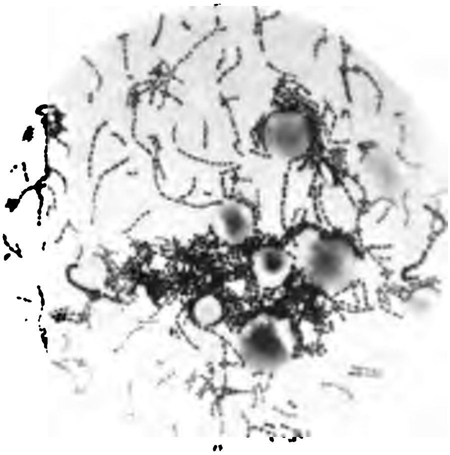

FIG. 6.

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TILDEN FOUNDATIONS.

PLATE XXII.

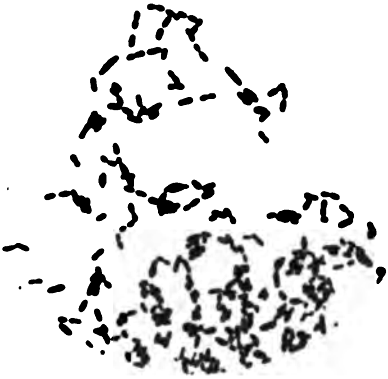

FIG. 7.

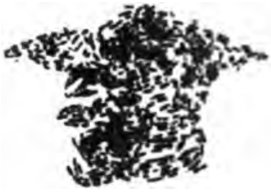

FIG. 8.

FIG. 9.

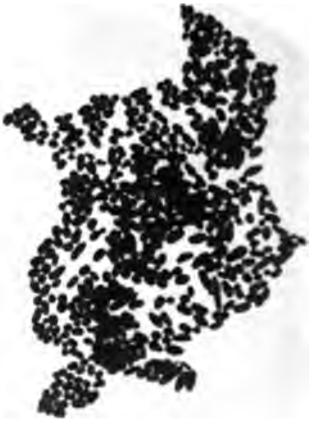

FIG. 10.

STREPTOCOCCUS SCARLATINÆ.

PLATE XXII.

FIG. 7.

Streptococcus scarlatinæ, No. 15, isolated from nasal discharge. Edge of impression of agar colony, 1 day, showing bacillary forms.

[Magnifying power, 1,000.]

FIG. 8.

Streptococcus scarlatinæ, No. 20. Impression of a gelatine colony, 3rd day, showing bacillary forms.

[Magnifying power, 1,000.]

FIG. 9.

Streptococcus scarlatinæ, after passage through a mouse. Culture of the streptococcus most frequently recovered therefrom, in agar condensation-fluid, 48 hours, showing "lace-work" arrangement.

[Magnifying power, 500.]

FIG. 10.

The same streptococcus. Impression of a gelatine colony, 3rd day, showing bacillary forms.

[Magnifying power, 1,000.]

STREPTOCOCCUS SCARLATINÆ.

PLATE XXIII.

Fig. 11.

The entirely bacillary form recovered from the mouse, or bacillus conglomeratus. Broth, 1 day, showing conglomerate masses of the growth.

(Compare Fig. 1.)

[Magnifying power, 16.]

Fig. 12.

The edge of one of the conglomerate masses in Fig. 11, showing bacillary forms, often arranged in parallels, and some of them curved.

[Magnifying power, 1,000.]

Fig. 13.

An example of bacillus conglomeratus from another case. Broth, 2 days, showing streptococcus-like curling and arrangement of the chains.

[Magnifying power, 1,000.]

PLATE XXIII.

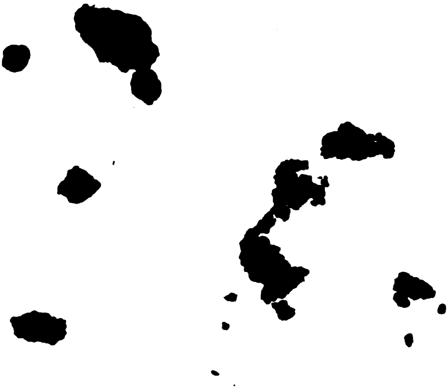

FIG. 11.

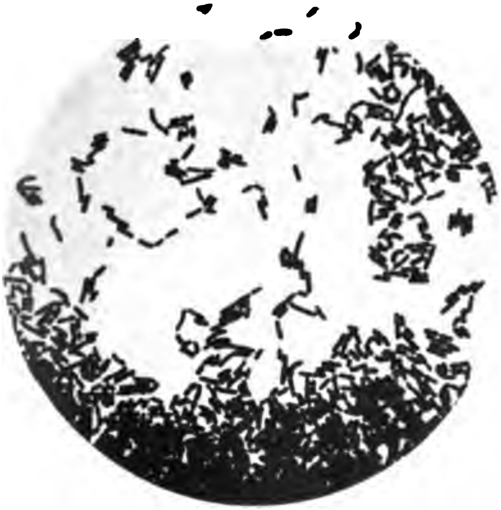

FIG. 12.

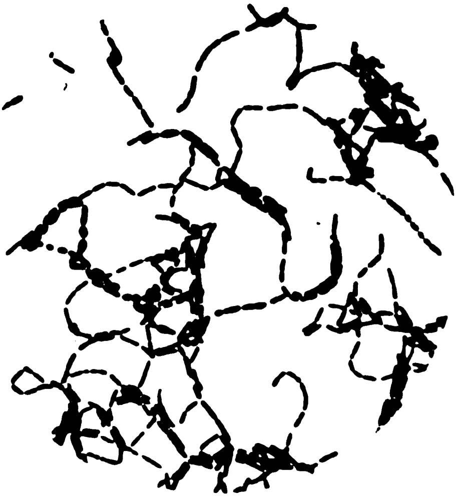

FIG. 13.

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PLATE XXIV.

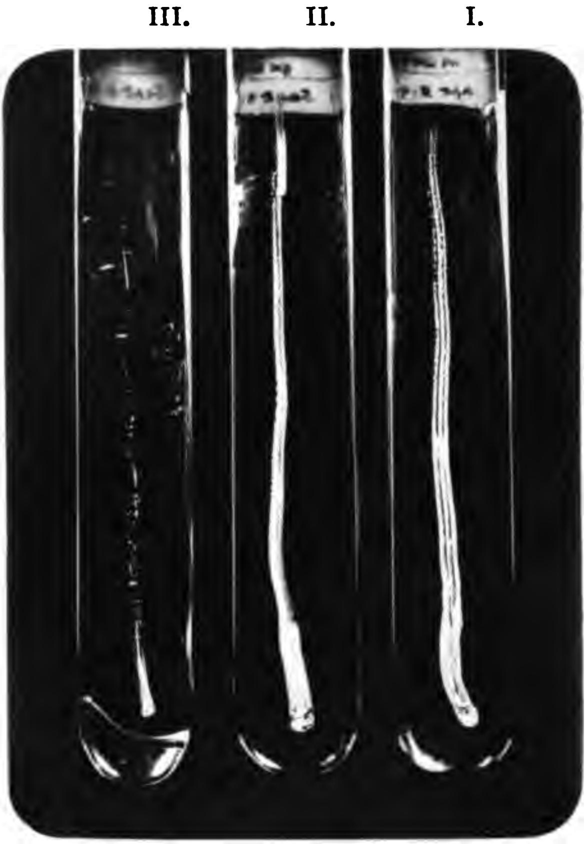

Fig 14.

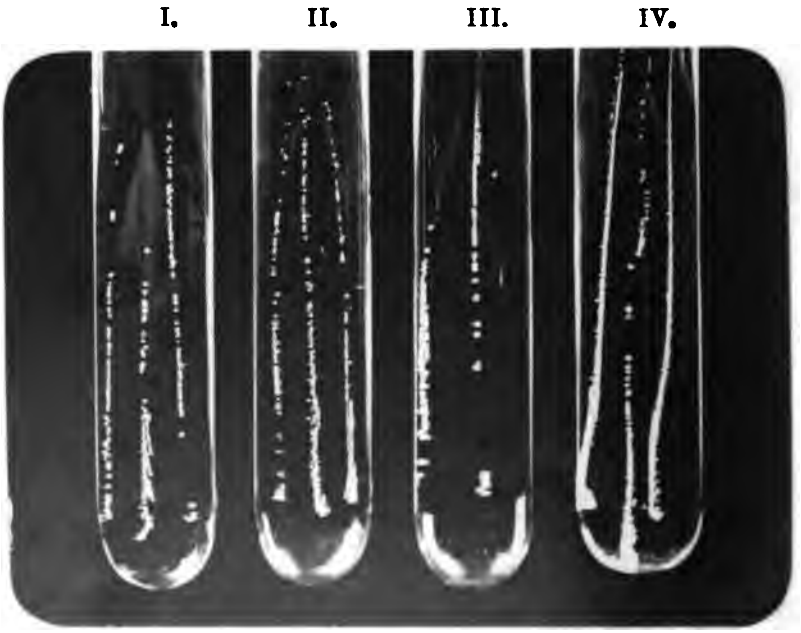

Fig. 15.

STREPTOCOCCUS SCARLATINÆ.

PLATE XXIV.

FIG. 14.

Three gelatine streak cultures, made on the same day and kept under the same circumstances. Tube I., streptococcus medius pyogenes, isolated from the throat of a case of diphtheria, and very virulent. Tube II., streptococcus brevis pyogenes, isolated from the throat of a case of membranous pharyngitis, and also very virulent. Tube III., streptococcus scarlatinæ, No. 52, isolated from the throat of a case of scarlatina, and though virulent, much less intensely so than the other two. The growth of streptococcus scarlatinæ is seen to be much slower than that of the other two. This is a difference originally described by Dr. Klein.

FIG. 15.

Four gelatine streak cultures, made on the same day and kept under the same conditions. Tube I., bacillus conglomeratus from case 52. Tube II., streptococcus scarlatinæ after passage through a mouse, from case 15. Tube III., bacillus conglomeratus from case 51. Tube IV., streptococcus scarlatinæ from the pleural effusion. These gelatine cultures are 14 days old. The growth of bacillus conglomeratus is practically indistinguishable to the eye from that of streptococcus conglomeratus.

STREPTOCOCCUS SCARLATINÆ.

PLATE XXV.

FIG. 16.

Two gelatine streak cultures, made on the same day and kept under the same conditions. Tube I., bacillus conglomeratus. Tube II., bacillus diphtheriæ. The age of the cultures is 16 days. The difference between the much slighter and slower growth of B. conglomeratus and the thicker and faster growth of B. diphtheriæ is here well seen.

FIG. 17.

Two broth cultures of streptococcus scarlatinæ from case IX. Tube I., was inoculated directly from an enlarged cervical gland of this case. Tube II. from a single colony of an agar plate from the secretion on the surface of the tonsil. Both are absolutely pure cultures. That from the cervical gland direct is particularly typical of streptococcus scarlatinæ or conglomeratus.

FIG. 18.

A typical pure-culture of the streptococcus most frequently obtained from the scarlatinal cadaver. This broth was inoculated with a drop of the heart's blood of case X. The conglomeration of the growth at the foot of the tube is obvious. The culture is two days old.

FIG. 19.

Broth sub-culture of streptococcus medius or pyogenes isolated from the spleen of a case of septicæmia. Instead of the conglomerate mass of Fig. 18, here a collection of powder and flakes is seen at the foot of the tube. Culture two days old.

PLATE XXV.

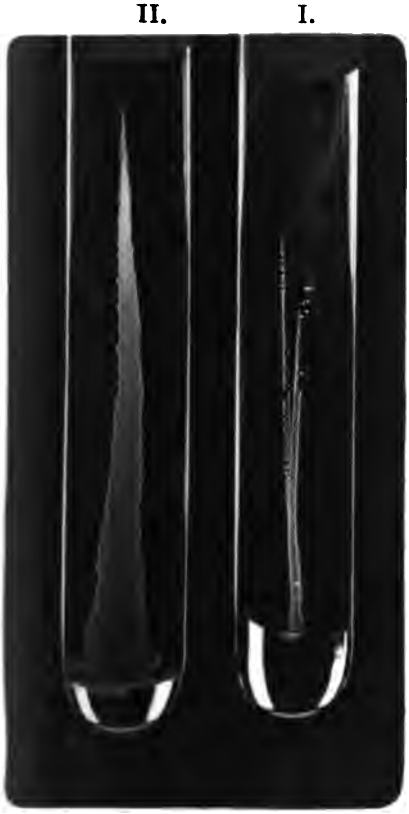

FIG. 16.

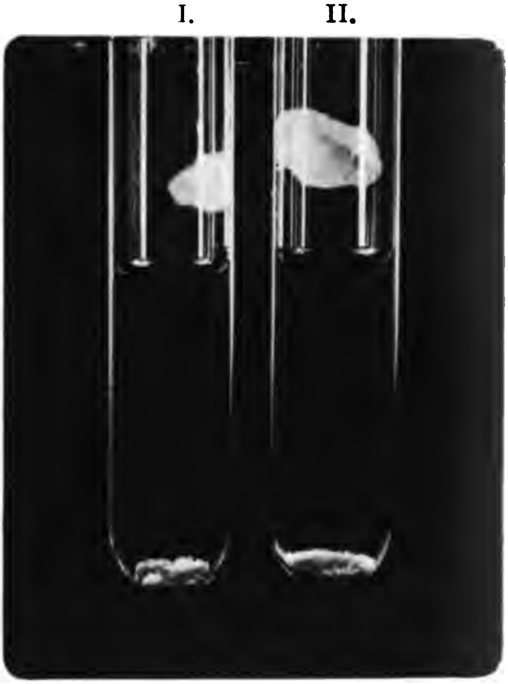

FIG. 17.

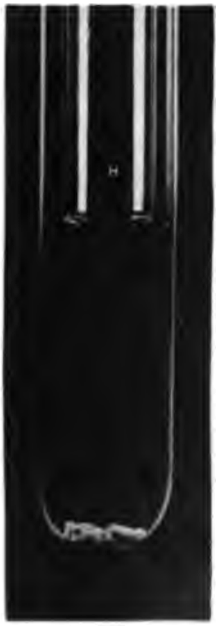

FIG. 18.

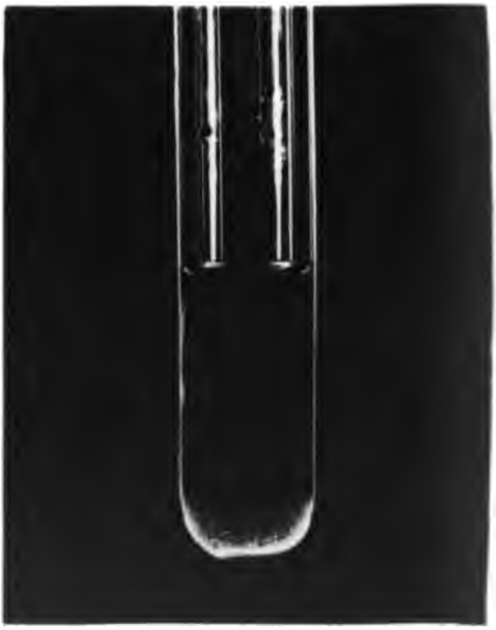

FIG. 19.

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TILDEN FOUNDATIONS.

PLATE XXVI.

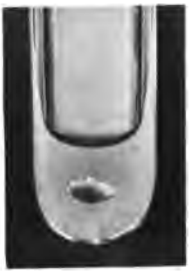

FIG. 20.

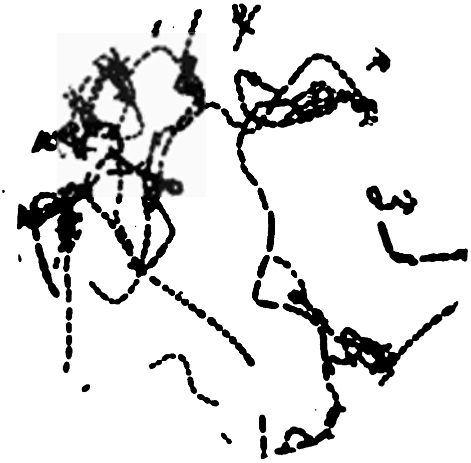

FIG. 21.

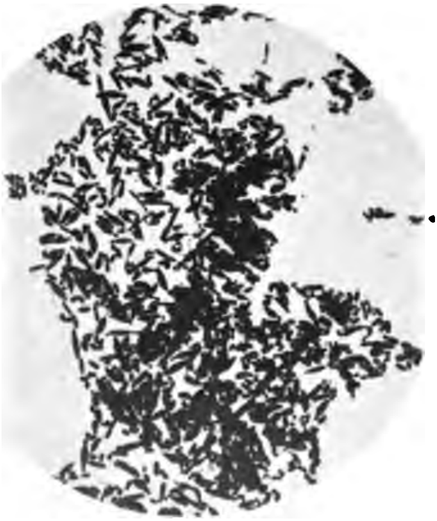

FIG. 22.

FIG. 23.

STREPTOCOCCUS SCARLATINÆ.

PLATE XXVI.

FIG. 20.

Pure culture of the streptococcus most frequently obtained from the scarlatinal cadaver. The agar condensation-fluid was inoculated in this case directly from an enlarged cervical gland of case II. No colonies have yet appeared on the surface of the agar. The conglomerate growth is here seen beginning as described in the text. Culture 1–2 days old.

FIG. 21.

Streptococcus scarlatinæ isolated from the pleural effusion. Forty-eight hours' growth in agar condensation-fluid showing bacillary forms.

[Magnifying power, 1,000.]

FIG. 22.

The same streptococcus after being in culture for a year. Impression of a gelatine colony, fourth day. Note the spindles and bacillary forms as seen in the gelatine colonies of S. scarlatinæ or conglomeratus.

[Magnifying power, 1,000.]

FIG. 23.

An example of a streptococcus recovered from the scarlatinal cadaver, admitting at once of identification with streptococcus scarlatinæ. Broth culture one day old inoculated directly from the kidney of case IV. The characteristic conglomerate masses of streptococcus scarlatinæ are here seen. Compare Figs. 1 and 11.

[Magnifying power, 16.]

STREPTOCOCCUS SCARLATINÆ.

PLATE XXVII.

FIG. 24.

Sub-culture of this example of streptococcus scarlatinæ in agar condensation fluid, 1 day old, showing bacillary forms among the cocci. The growth is very coherent and has been separated by crushing between 2 coverglasses. The purity of this culture was proved.

[Magnifying power, 1,000.]

FIG. 25.

Sub-culture of the same organism in the condensation fluid of a blood-serum culture, 1 day old. The bacillus-formation is here suppressed, the streptococcus phase being well seen.

[Magnifying power, 1,000.]

FIG. 26.

Impression of a gelatine colony of the same organism, 10 days' old. Note characteristic bacillary and spindle forms as seen in impressions of the gelatine colonies of streptococcus scarlatinæ.

[Magnifying power, 1,000.]

FIG. 27.

Example of a streptococcus recovered from the scarlatinal cadaver and not admitting at once of identification with streptococcus scarlatinæ The present is a photograph of a microscopical preparation of the broth culture shown macroscopically in Fig. 18. This broth culture was inoculated with the heart's blood of case X, and is a pure culture of this streptococcus. Note the conspicuous conglomeration.

[Magnifying power, 70.]

PLATE XXVII.

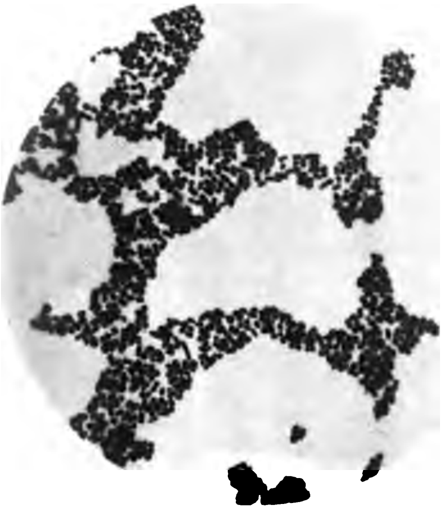

FIG. 24.

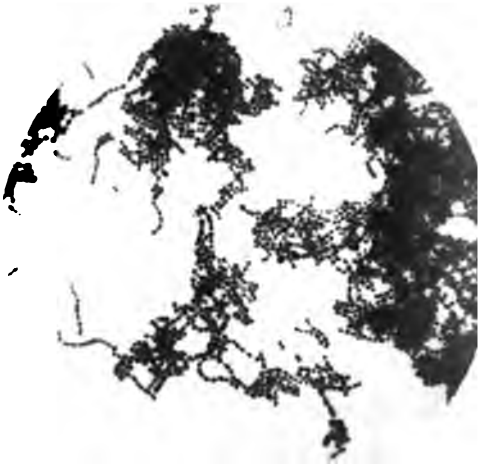

FIG. 25.

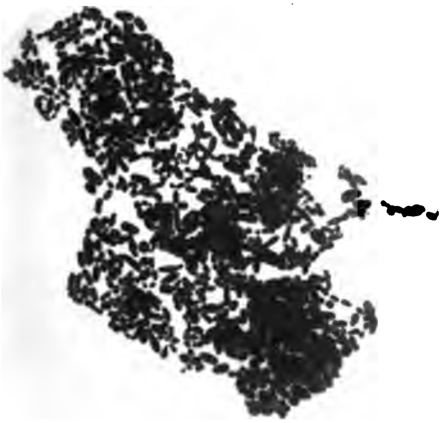

FIG. 26.

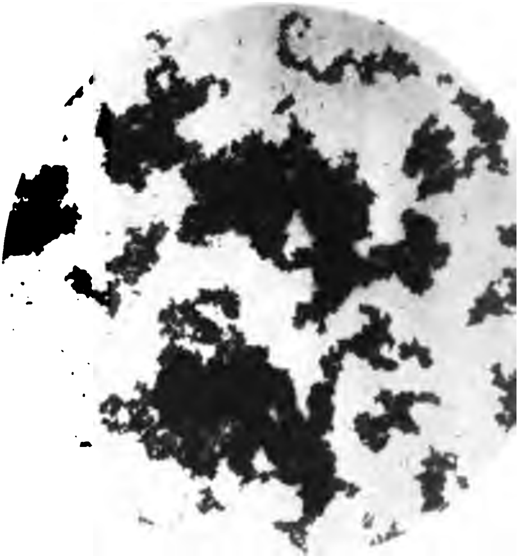

FIG. 27.

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PLATE XXVIII.

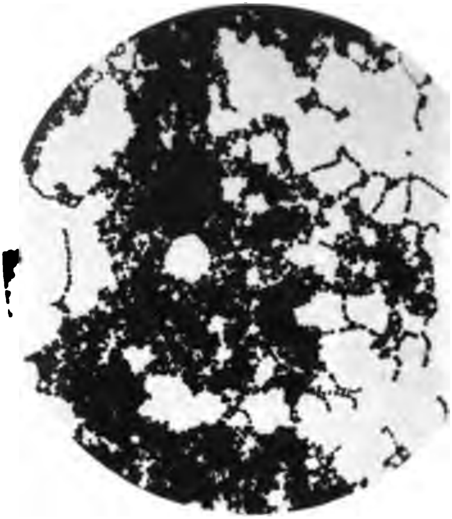

FIG. 28.

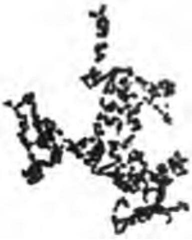

FIG. 29.

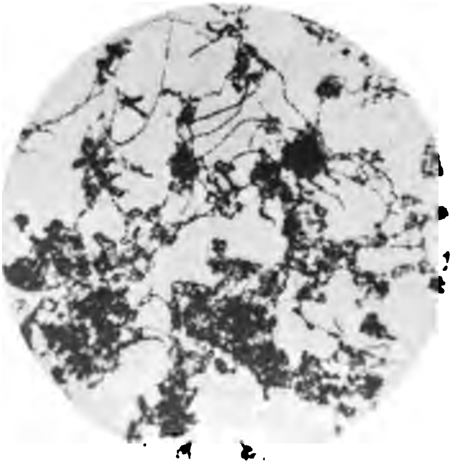

FIG. 30.

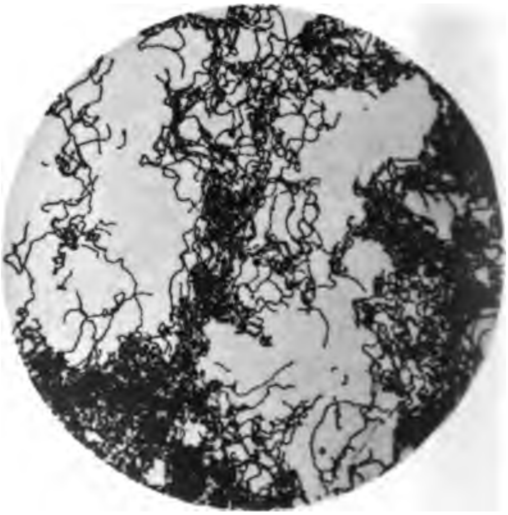

FIG. 31.

STREPTOCOCCUS SCARLATINÆ.

PLATE XXVIII.

FIG. 28.

Similar culture of the same organism recovered in this case from the kidney of case X.

[Magnifying power, 1,000.]

FIG. 29.

48-hours' culture of this streptococcus in agar condensation fluid, showing bacillary forms. The inoculation was here made from a dilution of the heart's blood of case VI.

[Magnifying power, 1,000.]

FIG. 30.

48-hours' culture in agar condensation fluid of the streptococcus obtained from the spleen of case VIII., showing "lace-work." This organism has now been definitely identified with S. scarlatinæ. (Compare Fig. 9.)

[Magnifying power, 500.]

FIG. 31.

Another form of lace-work. Here chains are much better developed. The agar condensation fluid was inoculated in this case from the liver of case II.

[Magnifying power, 350.]

STREPTOCOCCUS SCARLATINÆ.

PLATE XXIX.

FIG. 32.

Tonsil of case III. Section of the organ just below the surface showing a blood vessel free of streptococcus, and the tonsillar tissue on each side crowded with this organism. The streptococcus was readily cultivated from this material.

[Magnifying power, 1,000.]

FIG. 33.

Section of an enlarged cervical gland of the same case, showing a small blood vessel choked with the streptococcus of which a pure culture was obtained.

[Magnifying power, 1,000.]

FIG. 34.

Section of an enlarged cervical gland of case II. The present photograph shows a field toward the outer edge of the gland. Large masses of streptococcus are here seen in situ. A pure culture was obtained, *see* fig. 20.

[Magnifying power, 500.]

PLATE XXIX.

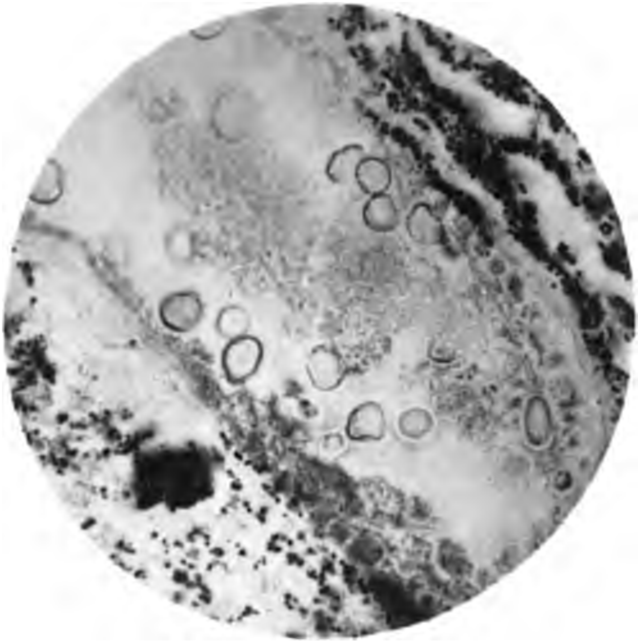

FIG. 32.

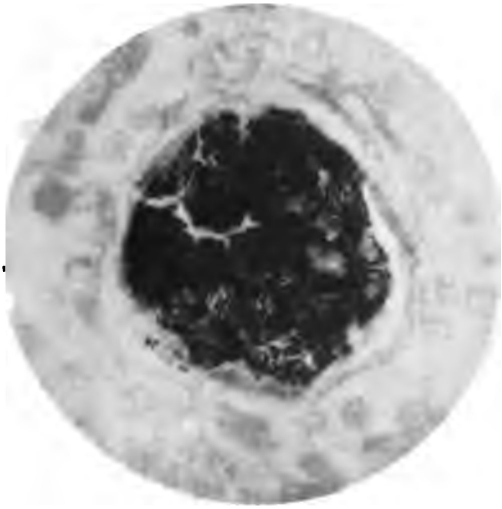

FIG. 33.

FIG. 34.

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TILDEN FOUNDATIONS

PLATE XXX.

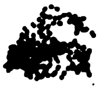

FIG. 35.

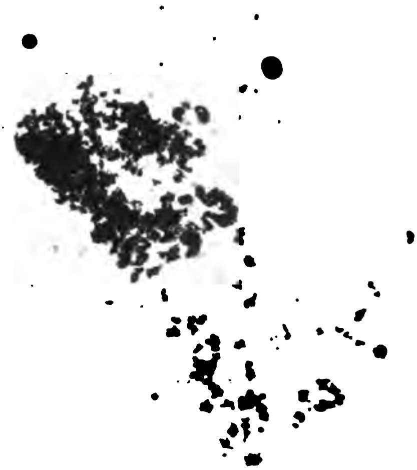

FIG. 36.

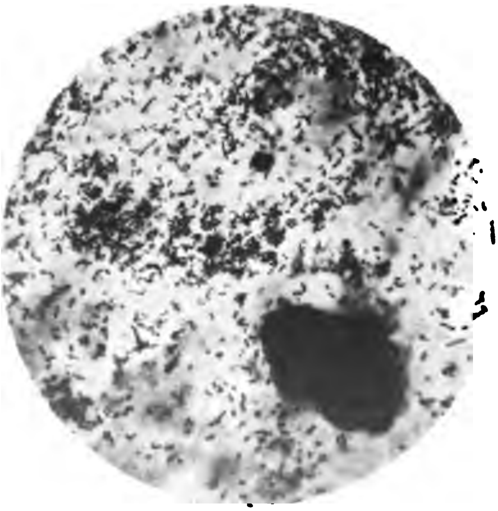

FIG. 37.

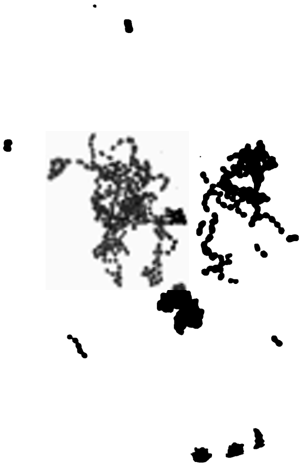

FIG. 38.

STREPTOCOCCUS SCARLATINÆ.

PLATE XXX.

FIG. 35.

Heart's blood of case I., showing streptococcus scarlatinæ in situ. A pure culture of this organism was obtained from this material. Clinically, the case was a remarkably pure one of scarlatina.

[Magnifying power, 1,000.]

FIG. 36.

Heart's blood of case III., showing mass of streptococcus in situ. A pure culture of the organism was obtained from this material.

[Magnifying power, 250.]

FIG. 37.

Heart's blood of a mouse that died fourth day after inoculation with the heart's blood shown in the preceding photograph. A pure culture obtained.

[Magnifying power, 500.]

FIG. 38.

Heart's blood of case V., showing streptococcus in situ. This organism was in an overwhelming majority in cultures from this blood.

[Magnifying power, 1,000.]

STREPTOCOCCUS SCARLATINÆ.

PLATE XXXI.

FIG. 39.

Spleen of case VIII., showing masses of streptococcus scarlatinæ in situ. A pure culture obtained.

[Magnifying power, 500.]

FIG. 40.

Kidney of case III., showing masses of streptococcus in situ in blood vessel. A pure culture obtained.

[Magnifying power, 1,000.]

FIG. 41.

Liver of case VIII., showing masses of streptococcus scarlatinæ in situ. A pure culture was obtained.

[Magnifying power, 1,000.]

PLATE XXXI.

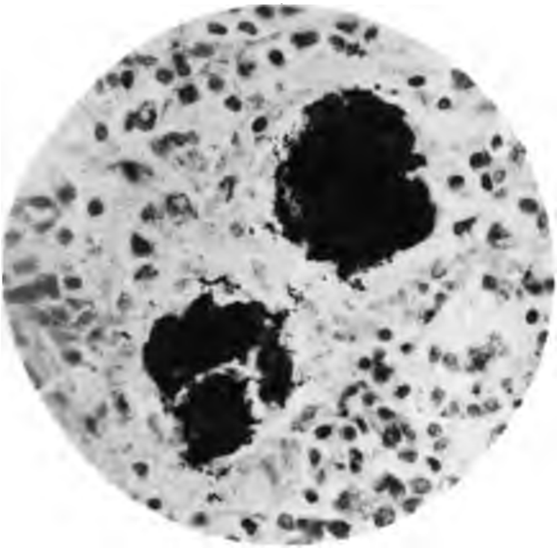

FIG. 39.

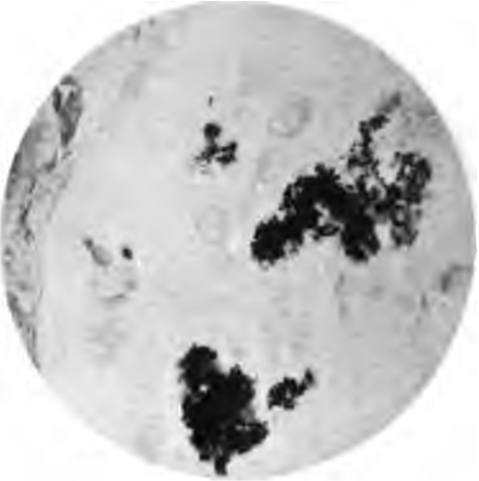

FIG. 40.

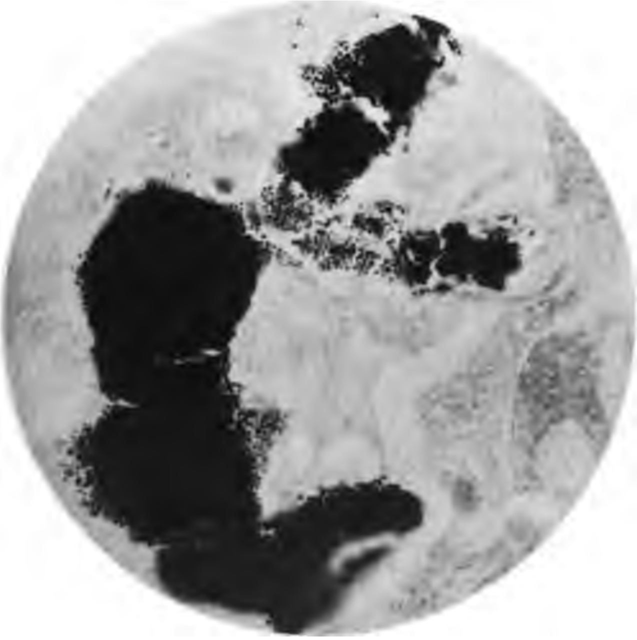

FIG. 41.

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ASTOR, LENOX AND
TILDEN FOUNDATIONS.

PLATE XXXII.

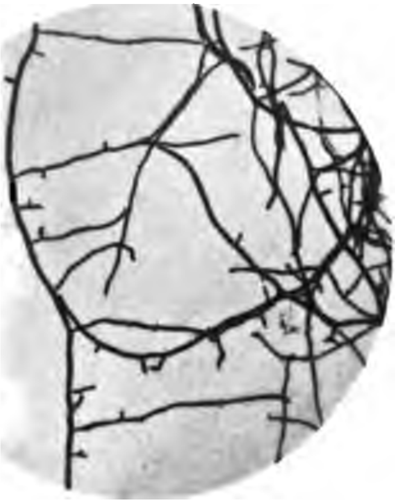

FIG. 1.

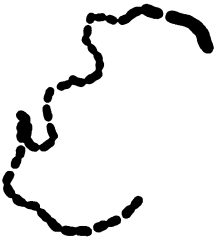

FIG. 2.

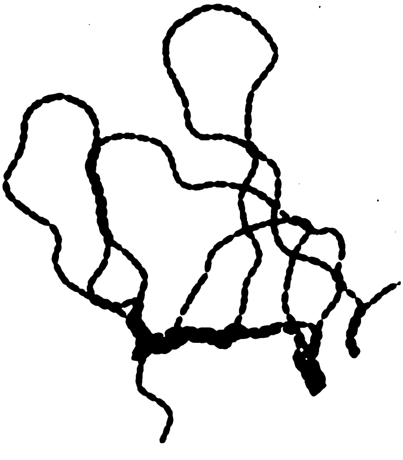

FIG. 3.

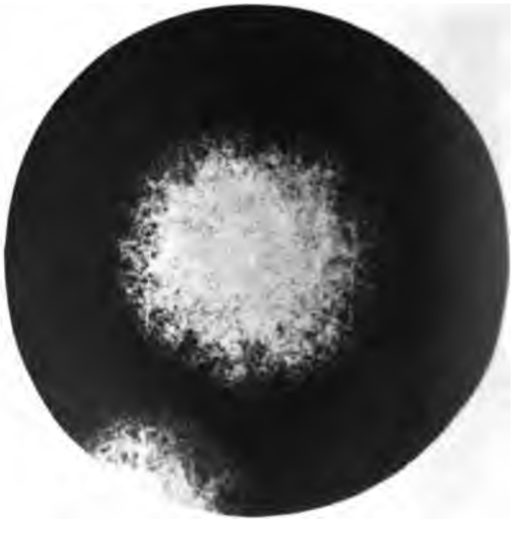

FIG. 4.

CHICHESTER SOILS.

PLATE XXXII.

FIG. 1.

Microscopic preparation from a broth culture (48 hours at 37° C.) of a cladothrix (? cladothrix odorifera) isolated from Chichester soil (fever area IV.), which in cultures gave rise to the peculiar earthy odour emanating from moist soil on a warm day. Stained by Gram's method.

[Magnifying power, 1,000.]

BACTERIA IN SOIL WASHINGS.

FIG. 2.

Microscopic preparation from a broth culture of a soil microbe [? streptococcus I]. This microbe was finally classed as a bacillus simulating a streptococcus. Stained by Gram's method.

[Magnifying power, 1,000.]

FIG. 3.

Microscopic preparation from a broth culture (24 hours at 20° C.) of soil streptococcus II. Stained by Gram's method.

[Magnifying power, 1,000.]

FIG. 4.

Surface Agar plate culture (48 hours at 20° C.) of soil streptococcus II.

[Magnifying power, 85.]

BACTERIA IN SOIL WASHINGS
AND
STREPTOCOCCI FROM WATER.

PLATE XXXIII.

FIG. 5.

Broth cultures of streptococci, namely :—

Left tube.—Water streptococcus IV. (24 hours at 37° C.) showing diffuse cloudiness.

Middle tube.—Soil streptococcus II. (24 hours at 20° C.), showing transparency of medium and white, fleecy, cloudy growth.

Right tube.—Water streptococcus V. (24 hours at 37° C.), showing diffuse cloudiness.

The left and right tubes, of course, illustrate bacteria from water, not from soil.

[About natural size.]

BACTERIA IN SOIL WASHINGS.

FIG. 6.

Microscopic preparation from a broth culture (24 hours at 37° C.) of soil streptococcus III. Stained by Gram's method.

[Magnifying power, 1,000.]

FIG. 7.

"Impression" preparation from a surface gelatine plate culture (48 hours at 20° C.) of soil streptococcus IV. Stained with methylene blue.

[Magnifying power, 1,000.]

PLATE XXXIII.

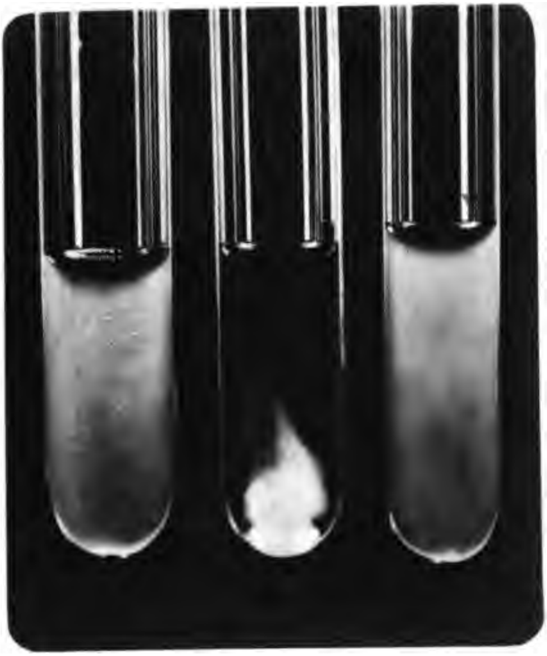

FIG. 5.

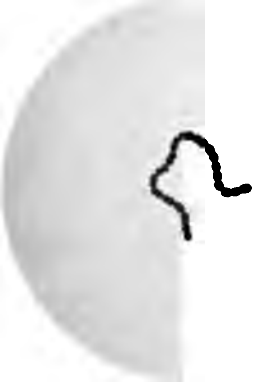

FIG. 6.

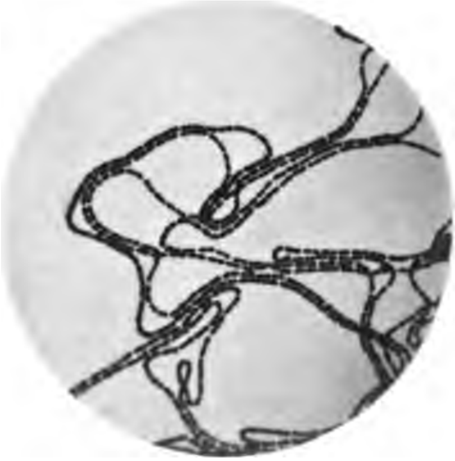

FIG. 7.

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PLATE XXXIV.

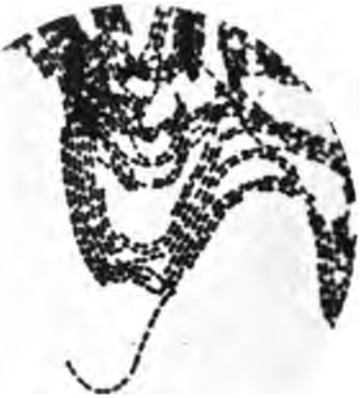

FIG. 8.

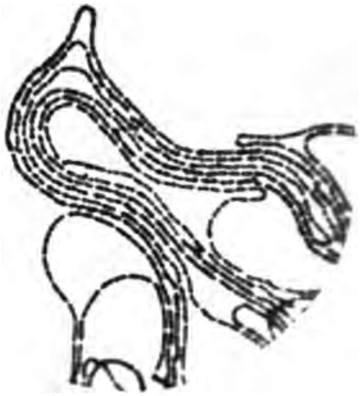

FIG. 9.

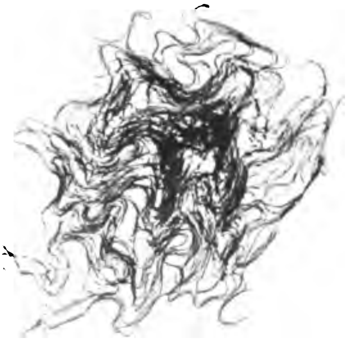

FIG. 10.

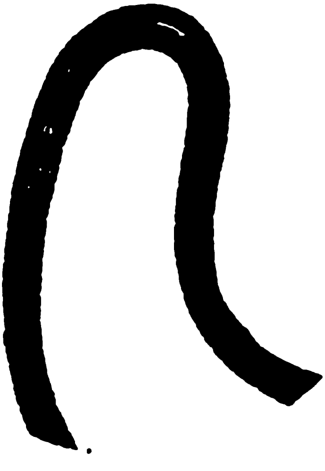

FIG. 11.

BACTERIA IN SOIL WASHINGS.

PLATE XXXIV.

FIG. 8.

"Impression" preparation from a surface gelatine plate culture (48 hours at 20° C.) of soil streptococcus V. Stained with methylene blue.

[Magnifying power, 1,000.]

FIG. 9.

"Impression" preparation from a surface gelatine plate culture (48 hours at 20° C.) of soil streptococcus VI. Stained with methylene blue.

[Magnifying power, 1,000.]

FIG. 10.

"Impression" preparation from a surface gelatine plate culture (48 hours at 20° C.) of soil streptococcus VII. Stained with methylene blue.

[Magnifying power, 100.]

FIG. 11.

"Impression" preparation from a surface gelatine plate culture (48 hours at 20° C.) of soil streptococcus IX. Stained with methylene blue.

[Magnifying power, 1,000.]

BACTERIA IN SOIL WASHINGS.

PLATE XXXV.

Fig. 12.

"Impression" preparation from a surface gelatine plate culture (48 hours at 20° C.) of soil streptococcus IX. Stained with methylene blue.

[Magnifying power, 125.]

STREPTOCOCCI FROM WATER.

Fig. 13.

Microscopic preparation from an agar culture of water streptococcus IV., showing chains of cocci and involution forms. Stained by Gram's method.

[Magnifying power, 500.]

Fig. 14.

Microscopic preparation from an agar culture of water streptococcus V., showing cocci in chains and masses and well marked involution forms. Stained by Gram's method.

[Magnifying power, 1,000.]

Fig. 15.

Microscopic preparation from a broth culture (24 hours 37° C.) of water streptococcus VII. Stained by Gram's method.

[Magnifying power, 1,000.]

PLATE XXXV.

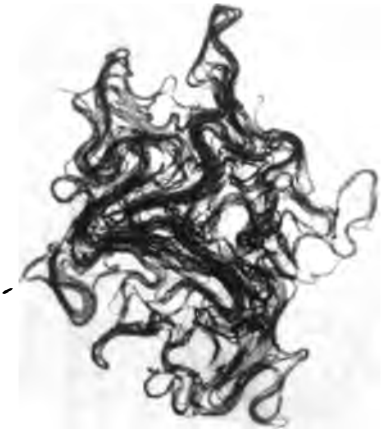

FIG. 12.

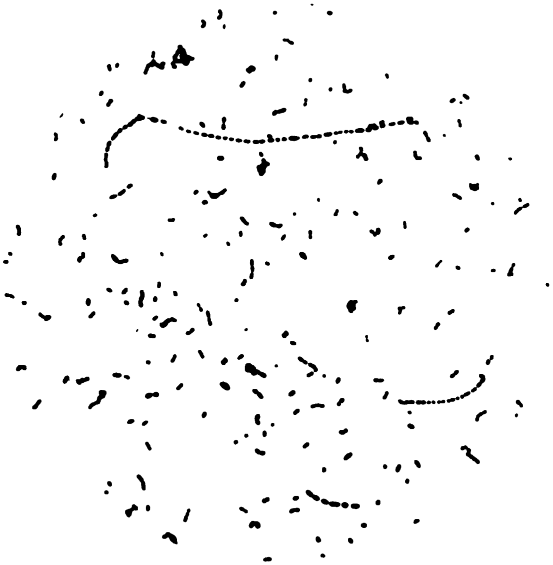

FIG. 13.

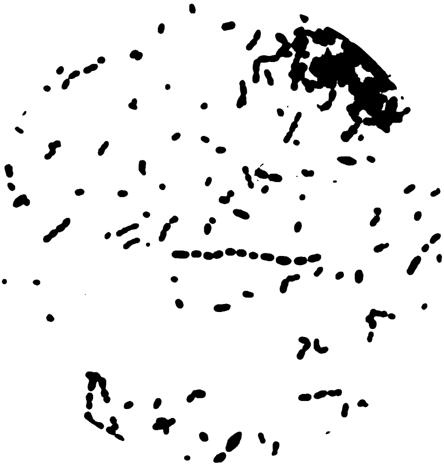

FIG. 14.

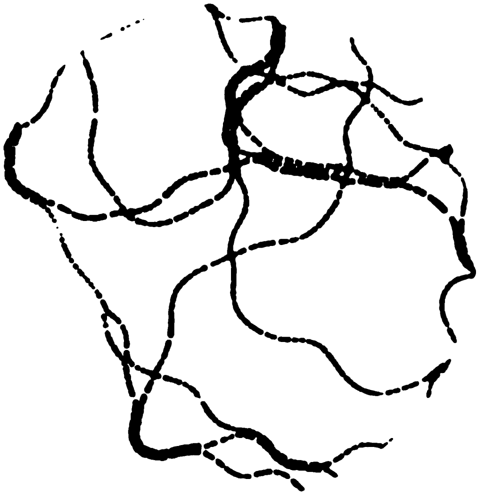

FIG. 15.

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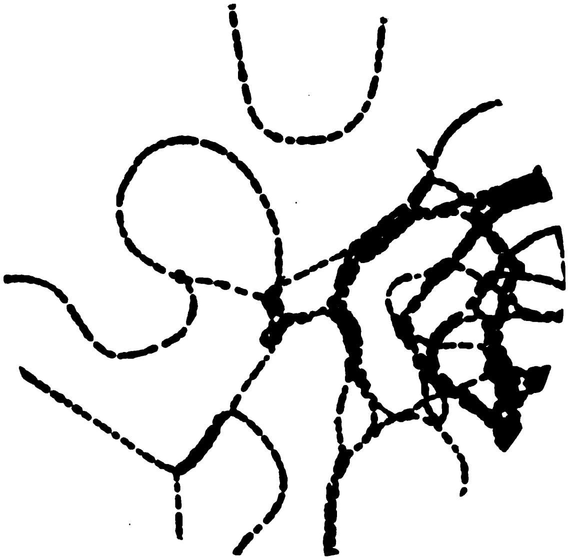

FIG. 16.

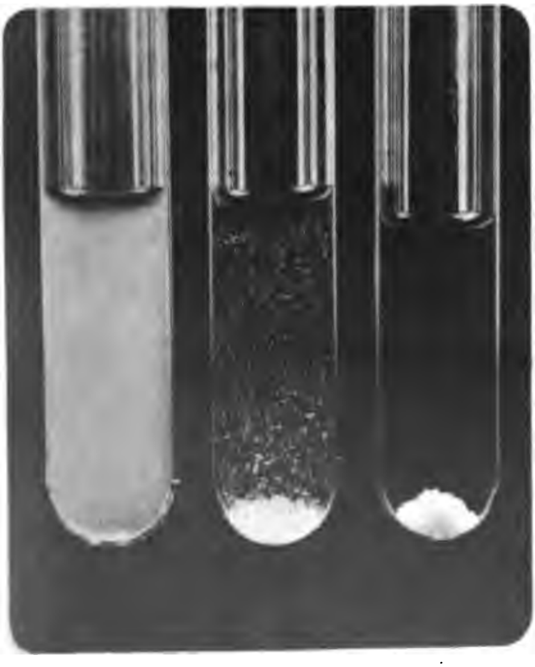

FIG. 17.

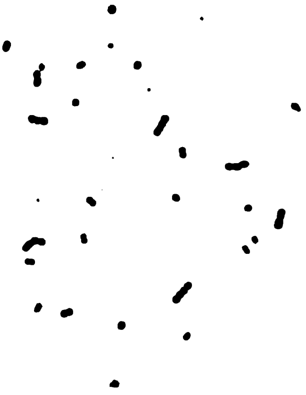

FIG. 18.

STREPTOCOCCI FROM WATER.

PLATE XXXVI.

FIG. 16.

Microscopic preparation from a broth culture (24 hours at 37° C.) of water streptococcus VIII. Stained by Gram's method.

[Magnifying power, 1,000.]

FIG. 17.

Cultures of streptococci, namely :—

Left tube.—Broth culture (4 days at 37° C.) of water streptococcus XI., showing diffuse cloudiness.

Middle tube.—Gelatine culture (24 hours at *blood-heat*) of water streptococcus VIII., showing granular cloudiness.

Right tube.—Broth culture (5 days at 37° C.) of water streptococcus VIII., showing transparency of medium and white fleecy cumulus-like growth at the foot of the tube.

[About natural size.]

FIG. 18.

Microscopic preparation from a broth culture (48 hours at 37° C.) of water streptococcus XI. Stained by Gram's method.

[Magnifying power, 1,000.]

STREPTOCOCCI FROM WATER.

PLATE XXXVII.

FIG. 19.

Microscopic preparation from a broth culture (48 hours at 37° C.) of water streptococcus XII. Stained by Gram's method.

[Magnifying power, 1,000.]

FIG. 20.

Microscopic preparation from a broth culture (48 hours at 37° C.) of water streptococcus XIV. Stained by Gram's method.

[Magnifying power, 1,000.]

FIG. 21.

Microscopic preparation from a broth culture (24 hours at 37° C.) of water streptococcus XVI. Stained by Gram's method.

[Magnifying power, 1,000.]

FIG. 22.

Same as Fig. 21, but a lower magnification.

[Magnifying power, 500.]

PLATE XXXVII.

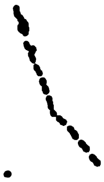

Fig. 19.

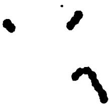

Fig. 20.

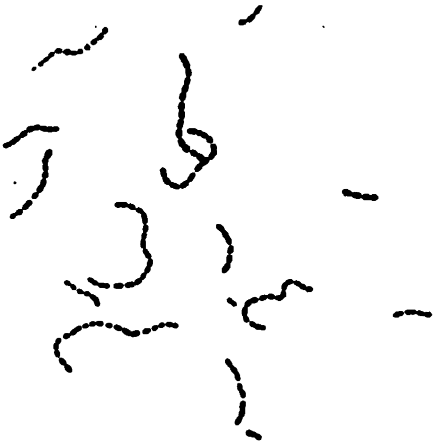

Fig. 21.

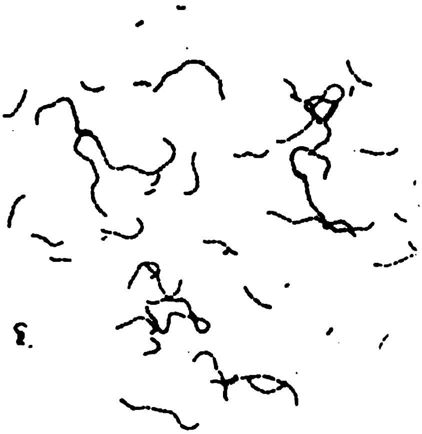

Fig. 22.

PLATE XXXVIII.

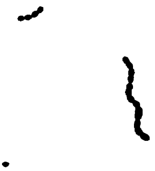

FIG. 23.

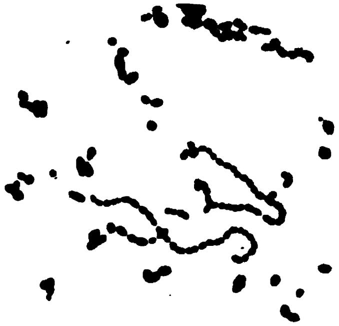

FIG. 24.

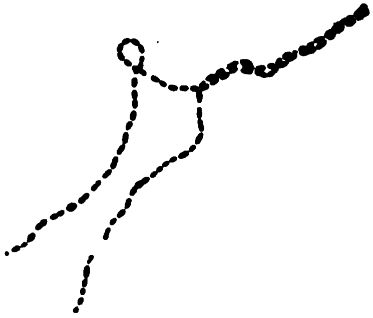

FIG. 25.

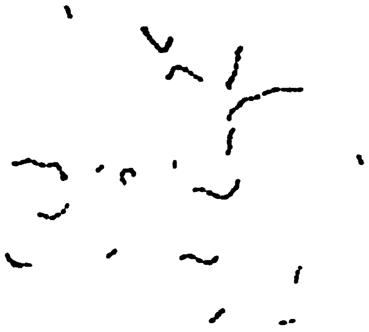

FIG. 26.

STREPTOCOCCI FROM WATER (AND MUD).

PLATE XXXVIII.

FIG. 23.

Microscopic preparation from a broth culture (24 hours at 37° C.). Stained by Gram's method.

[Magnifying power, 1,000.]

FIG. 24.

Microscopic preparation from a broth culture (72 hours at 37° C.) of water streptococcus XVIII. Showing chains of cocci and well marked involution forms. Stained by Gram's method.

[Magnifying power, 1,000.]

FIG. 25.

Microscopic preparation from a broth culture (72 hours at 37° C.) of *mud* streptococcus I. Stained by Gram's method.

[Magnifying power, 1,000.]

FIG. 26.

Microscopic preparation from a broth culture (48 hours at 37° C.) of *mud* streptococcus II. Stained by Gram's method.

[Magnifying power, 1,000.]

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